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ABSTRACT

This study represents one phase of a broader research project designed to develop and test the Occupation Analysis Inventory (OAI). The specific objective of the present investigation was to systematically derive a comprehensive set of work dimensions that could be used in describing and classifying jobs for educational purposes. The OAI was applied to a sample of 400 jobs representative of the percentages of jobs in the major occupational categories of the "Dictionary of Occupational Titles." Duplicate ratings were obtained on a subsample of 134 jobs for reliability purposes. Seven separate principal components factor analyses were performed within groups of items corresponding to the following sections of the OAI: (1) Information Received, (2) Mental Activities, (3) Physical Work Behavior, (4) Representational Work Behavior, (5) Interpersonal Work Behavior, (6) Work Goals, and (7) Work Context. The item reliabilities obtained were, for the most part, acceptable. The results of the seven sectional factor analyses were found to be generally meaningful; of the 81 factors emerging from these analyses, 77 were interpreted. Some potential applications of the OAI dimensions were also discussed. It was noted, however, that both the stability and utility of these dimensions remain to be demonstrated. A related study is VT 015 084. (Author/JS)

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WORK DIMENSIONS DERIVED THROUGH SYSTEMATIC JOB ANALYSIS

A Study of the Occupation Analysis Inventory

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Report No. 5 of the Ergometric Research and Development Series

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PREFACE

Within the last century, American society has seen the virtual demise of the blacksmith and the rise of the nuclear physicist. This is scarcely surprising since it is in the nature of progress that new fields should arise and old ones become obsolete. Yet with the rise of new fields, we have also seen a concomitant increase in the number of different types of jobs. Where a blacksmith could once shoe your horse and repair your buggy, a host of people are now required to give proper attention to your car. This means that the training of individuals to fill positions in the working world has become more specialized, more complex, and more costly. As the realization of these problems has grown, research has been seeking a way to provide efficient and effective education for work at a cost that can be borne by our society.

One solution to the problem may lie in the concept of occupational clustering where people would be trained not for a single position, but for a group of positions all having similar characteristics. The human product of such training might then be capable of performing not one, but a whole range of jobs. The research reported in this monograph represents one of the first steps in developing a scientifically based set of job clusters. The derivation of work dimensions for the description of jobs lays the ground work for further research and development. Taken in conjunction with the variables in the Attribute Requirement Inventory, these dimensions provide a foundation for the development and description of occupational clusters and for further research in work behavior.

The Center extends its appreciation to Mr. Riccobono and Dr. Cunningham for their efforts on this report and to the Center's editorial and technical staff for assisting in its production. Special thanks are due Mr. William Ballenger and Mrs. Faye Childers for their assistance in processing and analyzing the data for this report.

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John K. Coster
Director

SUMMARY

This study represents one phase of a broader research project designed to develop and test the Occupation Analysis Inventory (OAI). The specific objective of the present investigation was to systematically derive a comprehensive set of work dimensions that could be used in describing and classifying jobs for educational purposes.

The OAI was applied to a sample of 400 jobs representative of the percentages of jobs in the major occupational categories of the Dictionary of Occupational Titles. Duplicate ratings were obtained on a subsample of 134 jobs for reliability purposes. All ratings were made from written job descriptions drawn from the files of the United States Employment Service. Seven separate principal components factor analyses were performed within groups of items corresponding to the following sections of the OAI: (1) Information Received, (2) Mental Activities, (3) Physical Work Behavior, (4) Representational Work Behavior, (5) Interpersonal Work Behavior, (6) Work Goals, and (7) Work Context.

The item reliabilities obtained were, for the most part, acceptable. The results of the seven sectional factor analyses were found to be generally meaningful; of the 81 factors emerging from these analyses, 77 were interpreted.

Some potential applications of the OAI dimensions were also discussed. It was noted, however, that both the stability and utility of these dimensions remain to be demonstrated.

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INTRODUCTION

Since the turn of the century, the rate of technological growth in the United States has been staggering. The impact of this technology has been felt by every segment of the population and has permeated every sphere of activity. Not the least affected by this technological advance is the field of occupational education. Today's educators are faced with the challenge of preparing individuals for a world of work which is only vaguely defined and in a constant state of transition. Vocational and technical curricula designed for specific occupations do not provide the individual with the flexibility required in this situation, the ability to adapt to rapidly changing work demands. Furthermore, there is increasing recognition of the need for occupationally related education (e.g., career awareness and exploration curricula in the early grades), which could not feasibly be geared to specific occupations. It seems apparent, therefore, that future occupational curricula must be based on a comprehensive taxonomy of work, rather than on ad hoc studies (and, sometimes, impressions and opinions) of specific jobs and occupations (Cunningham, Tuttle, Floyd, and Bates, 1971).

A current approach aimed at dealing with the problem of structure and organization in occupational education has been termed "occupational clustering." The rationale underlying the clustering approach holds that groups, or families, of occupations with similar educational requirements can be identified and that curricula can then be developed providing knowledges and skills common to the occupations within these clusters. Such an approach might prove applicable, for example, in the development of occupational awareness and exploration curricula, curricula directed toward general vocational capabilities, and more advanced and focused curricula (e.g., vocational and technical curricula) (Cunningham, 1971). Presumably, such curricula would be based on the characteristics defining their respective clusters. We could expect that the occupational clusters (and their defining characteristics) would be more general and inclusive the lower the grade level and the more general the curriculum.

Although occupational clustering offers some promise in seeking the solutions to certain educational problems, this approach also raises some troublesome questions. For instance, what are the variables, or characteristics, on which occupations should be described, compared, and classified? And even assuming that it is possible to establish valid occupational clusters without first defining a set of variables for classification purposes, how would we then determine what common denominators should be incorporated into the cluster curricula? Thus, there is a need for a comprehensive set of work variables, or dimensions, which could be applied to the description and classification of occupations for educational purposes; that is, variables which would provide the basis for a quantitative work taxonomy suitable to educational problems.

As noted previously (Cunningham, 1971), the efforts of many investigators, spread over a number of years, will be required to develop a comprehensive, multi-level taxonomy of work (ranging from sub-tasks to occupations); but since societal exigencies must be met in the interim, it is necessary that a practicable scheme for describing occupational characteristics be made almost immediately available for educational use. The Occupation Analysis Inventory (OAI) developed at the Center for Occupational Education represents an initial effort toward the development of one level of a work taxonomy--a level defined by descriptors which are as content-specific as possible, while retaining their applicability to the entire spectrum of occupations. The development of the OAI is discussed in a previous report (Cunningham, Tuttle, Floyd, and Bates, 1971).

The purpose of the present study was to derive a comprehensive set of work dimensions through application of the OAI in the analysis of a large, representative sample of jobs. In the area of curriculum development, such dimensions might be used not only for the purpose of occupational clustering (and the development of cluster curricula), but, alternatively, as a basis for the development of modular curricula which could be combined in accordance with the needs and requirements of specified classes of students and occupations. Other areas in which such work dimensions might find application include: (1) curriculum evaluation, (2) vocational (career) guidance and placement, (3) test development, (4) educational planning and administration, (5) job design, and (6) research related to career education. A more detailed discussion of these potential applications appears in an earlier paper (Cunningham, 1971).

REVIEW OF RELATED RESEARCH

The following section contains a selected review of the previous research relevant to the problem of identifying work dimensions. These studies have been divided into four categories, based on the methodology employed: (1) studies in which work dimensions are derived entirely on an a priori basis; (2) studies in which work dimensions are derived on the basis of overall similarity judgments of jobs; (3) studies in which work dimensions are derived on the basis of ratings of human attribute requirements of jobs (e.g., aptitudes, abilities, and interests); and (4) studies in which work dimensions are derived on the basis of ratings of jobs on work activity and condition statements.

"a priori" Work Dimensions

The most productive and influential application of the a priori approach to job classification occurred in a research program conducted by the United States Employment Service (USES). This project culminated in 1965 with the publication of the Third Edition of the Dictionary of Occupational Titles (DOT). As early as 1951, however, Studdiford proposed a new classification scheme which would ". . . group jobs which are alike with respect to fundamental work activities and worker requirements [p. 37]." The Functional Occupational Classification Project (FOCP), as it was called, included the following eight classification components (or criteria): (1) work done, (2) knowledges and abilities, (3) aptitudes, (4) physical demands, (5) temperament demands, (6) working conditions, (7) industry, and (8) training time. Each of these components was further subdivided into several factors or levels. The eight components were arrived at "rationally" through a series of discussions.

The functional job analysis system developed by the USES in connection with the occupational classification research project has been described by Fine (1955). The system was designed to analyze the "work performed" component of a job in terms of three subcomponents: worker functions; materials, products, and subject matter; and methods groups. Worker functions indicate what the worker does and are expressed by means of "work-action verbs." A total of 26 worker functions were organized into three hierarchies based on the premise that all jobs require workers to function in relation to "Things," "Data," and "People." Any particular function in a hierarchy includes all those which fall below it and is, in turn, subsumed under all functions which lie above it. One function from each hierarchy is needed to express the worker's total relationship to what gets done in the job. Thus, a job is assigned a weight of one to eight on each of these hierarchies such that the combined weights total 10; these weights constitute estimates of the level of functioning and the relative importance of things, data, and people in the job.

Following a series of successful tryouts with the Worker Function system, described above, Fine and Heinz (1958) proposed a three-dimensional

classification system in which the job-worker situation was represented by a three-part, nine-symbol code. The first part of the code consisted of three letters indicating the level of functioning and relative involvement of the worker with things, data, and people; the second part of the code was a three-digit number representing the work field (i.e., the work to be accomplished); and the last part of the code consisted of a three-digit number representing the material, product, subject matter, or service with which the worker and technology are primarily involved.

Another interesting conceptual approach to job description and classification has been reported by Hamreus and Langevin (1967). These investigators have developed a two-dimensional task classification scheme incorporating the DOT worker function categories (Fine, 1955; Fine and Heinz, 1958) and a hierarchical set of mental processes adopted from Altman (1966). The total classification scheme is represented in a function-by-process grid containing 220 cells.

In an application of their classification system, Hamreus and Langevin chose a sample of jobs from each of the following occupational categories identified by Altman (1966): Mechanical, Electrical, Spatial, Chemical-Biological, Symbolic, and People. An attempt was made to obtain a sample possessing the following characteristics: (1) jobs requiring some vocational education pre-training; (2) a wide variety of tasks among jobs; and (3) tasks that logically cluster into similar groups. The jobs in the sample were first analyzed for the purpose of identifying their basic task components; one or two basic tasks were selected in each job for subsequent analysis. Descriptions were then written for each of 27 selected basic tasks. The action statements making up these descriptions constituted the basic elements of analysis in the study. Every task action under each of the 27 basic tasks was assigned to one or more of the cells in the function-by-process matrix. This classification procedure involved the following steps: (1) analysis of the action in terms of its relevance to things, data, and people; (2) assignment of a function level to the action, under each of the three DOT worker-function categories (things, data, people); and (3) determination of the level of mental process required to perform each of the assigned functions. Through this procedure, every task action was assigned one or more three-element codes, each code representing a cell in the function-by-process grid. Next, similarity indices were computed between each pair of basic tasks based on commonalities in the classification of their task action statements, and a cluster analysis procedure (Silverman, 1966) applied to the resulting matrix of similarity indices. Three clusters, ranging in size from 3 to 11 basic tasks each, emerged from this analysis. When the basic tasks in these clusters were substituted with the titles of their respective jobs, the three clusters were found to be characterized by (1) drafting jobs, (2) truck repair jobs, and (3) electronics and welding repair jobs. The authors cautioned that though these clusters have "high face validity," it would be unwise to generalize from these results because of the rather limited number of jobs and basic tasks employed in the study. It was further noted, however, that these results do have implications for developing vocational training curricula ". . . having a much broader base than is presently the case [Hamreus and Langevin, 1967, p. 76]."

A third *a priori* occupational classification system has been proposed by Roe (1954). Under this scheme, jobs are first classified into "groups" according to their primary focus of activity. The group categories are: Physical, Social Welfare and Personal Service, Persuasive Business, Government and Industry, Mathematics and Physical Science, Biological Science, Humanities, and Arts. Jobs are also classified into "levels" according to the type of function performed. The level categories include: Innovation and Independent Responsibility; Transmission-professional; Transmission-semi-professional; Application-professional; Application-semi-professional and Entrepreneur; Support and Maintenance-skilled; Support-semi-skilled; and Support-unskilled. This classification scheme is represented by an 8 X 8 matrix, and any particular job will fall into one of the 64 possible cells. It is not clear why the author selected these particular group and level classifications, although some relations with interest factors and other classifications of occupations are noted.

Holland (1959) has proposed a two-dimensional system for classifying occupations based on a theory of personality types. The first dimension, "occupational environments," is divided into six major categories: (1) Motoric (technical, skilled, and laboring occupations), (2) Intellectual (scientific occupations), (3) Supportive (educational and social welfare occupations), (4) Conforming (office and clerical occupations), (5) Persuasive (sales and managerial occupations), and (6) Aesthetic (artistic, literary, and musical occupations). The second dimension was presented in terms of four hierarchical levels of occupational choice within each environmental category. The particular level of choice was assumed to be a function of the individual's intelligence and self-evaluation.

Since 1959, Holland's classification scheme has undergone several revisions and has been extended to include 431 occupations comprising approximately 95 percent of the labor force. Moreover, Holland *et al.* (1970) have recently attempted to validate his scheme against the 32 PAQ (Position Analysis Questionnaire) job dimensions derived by McCormick and his associates (see pp. 11 and 12 of this report for a discussion of the PAQ studies). This was accomplished by having judges assign 832 jobs from McCormick *et al.*'s sample to five of the Holland categories. (The Aesthetic category had to be omitted because McCormick's sample contained only two artistic jobs.) A one-way analysis of variance was then performed across the five Holland categories for each of the 32 PAQ dimensions, i.e., treating the five Holland categories as the independent variable and PAQ factor scores for jobs as dependent variables. All but one of the 32 separate analyses of variance were significant ($p < .001$) supporting the conclusion that" . . . the Holland classification, developed almost entirely from psychological data, also encompasses more objective, situational data about jobs [1970, p. 17]."

Overall Similarity Judgments of Jobs

Two studies have established similarities among occupations on the basis of overall similarity judgments. In the first of these, Gonyea (1961) attempted to identify the dimensions underlying job perceptions by using Case III of Andrews' A-technique, a method of nonserial matching (Andrews and Ray, 1957). The Job Perception Blank, consisting of two parallel lists of 30 occupational titles selected from the Holland Vocational Preference Inventory, was administered to 191 University of Maryland male freshmen. Both lists contained the same occupational titles but were arranged in different orders. For each title in list B the subject was asked to select from the remaining 29 occupational titles in list A the title which seemed to be most similar. The subject thus matched each of the 30 occupational titles with one of the remaining 29 titles. Due to various procedural difficulties, 91 records were excluded from the analysis. The records of the remaining students were used to construct a 30 X 30 estimated intercorrelation matrix, based on proportions of possible times pairs of jobs were judged similar. A first-order factor analysis of this matrix resulted in 12 oblique factors, and a subsequent factor analysis of the first-order matrix yielded five orthogonal second-order factors, or dimensions of job perceptions.

The reason that a considerable amount of data had to be discarded in the Gonyea study was primarily because of the difficulty the subjects encountered in using the nonserial matching technique. In a subsequent study, Gonyea and Lunneborg (1963) sought to eliminate this problem by using Case II of the A-technique, the method of triads. In this method, the stimuli are presented in groups of three, and the subject is asked to choose the member of the group which does not belong. While this procedure is easier for the subjects to understand than the Case III method, it is not nearly so economical. The stimuli in this study consisted of 22 occupational titles. Eight of these titles were chosen to represent the first-order factors from the original study, and four were selected from those which loaded on more than one first-order factor in that study. The remaining 10 titles represented occupations commonly listed by college students as vocational objectives. The 1,540 possible triads for these 22 occupational titles were distributed among 20 forms of a Job Perception Blank, with 77 triads on each form. The 20 forms were randomly distributed to 2,424 male and female freshmen at the University of Texas. Thus, each form was completed by an average of 121 subjects. A factor analysis of the 22 X 22 estimated intercorrelation matrix yielded five significant factors and two factors of "marginal" significance. The investigators reported that the five significant factors correspond directly to the five second-order factors obtained in the original study, thus providing evidence for the stability of the factor structure. Furthermore, the fact that the second study used a different population, different occupational titles, and a different procedure attests to the generality of the original findings.

Ratings of Jobs on Human Attributes

An early attempt to derive dimensions based upon attribute ratings of jobs was reported by Jaspen (1949). In this study, a Worker Characteristics Form consisting of 45 items, or traits, was used to rate a sample of 275 occupations representative of the DOT classification scheme. Traits judged to be present in less than 10 percent of the jobs were not included in the study, since they could not yield stable correlation coefficients. As a result, 25 of the traits were eliminated. Ratings for the remaining 20 traits plus two other job characteristics and a skill variable were intercorrelated. A factor analysis of the resulting 23 X 23 correlation matrix identified six meaningful factors: (1) Strength, (2) Intelligence, (3) Inspection, (4) Physically Unpleasant Working Conditions, (5) Manual Dexterity, and (6) Mechanical Information. It was suggested that such factors might be appropriate ". . . for the purpose of establishing a limited number (less than fifty) of occupational fields distinguished on the basis of worker characteristics for use in counseling. . . [p. 458]."

In a similar study, McCormick, Finn, and Scheips (1957) factor analyzed 44 human attribute variables on which 4,000 jobs had been rated by USES job analysts. These attributes fell into six major classes: training time, aptitudes, physical capacities, temperaments, interests, and working conditions. The factor analysis of the ratings yielded seven factors: (1) Mental and Educational Development vs. Adaptability to Routine, (2) Adaptability to Precision Operations, (3) Bodily Agility, (4) Artistic Ability and Aesthetic Appreciation, (5) Manual Art Ability, (6) Personal Contact Ability vs. Adaptability to Routine, and (7) Heavy Manual Work vs. Clerical Ability. Next, factor scores were derived for each of the 4,000 jobs by the Wherry-Doolittle test selection method. Factor score distributions for each factor were then examined and divided into "levels." Scores for one factor were categorized as "High," "Average," and "Low"; scores for the six remaining factors were dichotomized into "High" and "Low" categories. All possible permutations of these levels resulted in 192 unique combinations or "patterns" of factor scores. Most of the jobs, however, fell into a relatively small percentage of these patterns: 12 patterns accounted for 60 percent of the jobs in the sample, 20 patterns for 75 percent of the jobs, and 33 patterns for 88 percent of the jobs. The entire sample of jobs was accounted for by 115 patterns. The investigators were encouraged by these findings and concluded that ". . . jobs collectively do not scatter themselves to the four winds as far as job requirements are concerned, but rather tend to fall into certain predominant molds [p. 363]."

An attempt to define attribute dimensions of Air Force jobs has been reported by Norris (1956). In this study, a sample of 150 Air Force job descriptions was rated on each of 170 human traits. Because of limitations of the computer program, however, intercorrelations were computed only between the 130 most reliable traits. The resulting matrix was factor analyzed into 25 orthogonal dimensions, 11 of which had high

enough loadings to be considered meaningful. The author felt, however, that these 11 factors alone did not adequately define the variables. Thus, seven additional traits showing sufficient uniqueness were identified and added to the list, making a total of 18 relatively independent dimensions.

Thorndike et al. (1957) developed a 219-item Job Activities Blank representing 14 trait dimensions selected from those identified in the previously mentioned study by Norris. Each dimension was represented by from 7 to 20 items, the dimension score being simply the summation of responses for these items. This instrument was administered to 963 men in 25 Air Force jobs with instructions to rate each activity on a five-point frequency scale ranging from "A--never do it" to "E--do it very often. . . ." Although these 14 scales were presumed to be relatively independent, an intercorrelation matrix among the dimension scores showed some rather substantial correlations. A subsequent principal components factor analysis further reduced these 14 oblique dimensions to eight orthogonal factors. The data for the 25 jobs were then subjected to two separate cluster analyses based on a "Distance (D) Measure," an index of profile similarity. This involved computing similarity indices (D-scores) between all pairs of jobs and then deriving clusters, or families, of jobs which were most similar in terms of their trait requirements. In the first cluster analysis, the D-scores were computed from 13 of the 14 original trait dimension scores; in the second analysis, D-scores were based on the first five orthogonal factors previously mentioned. The correlation between the two sets of D-scores was .91, indicating rather close agreement between the two methods of measuring job similarity. Although the two methods were in perfect agreement in dividing the jobs into two clusters, there was considerable discrepancy between further subdivisions. The investigators concluded from these results that the relatively high correlations among the trait dimensions operated to reduce their effectiveness in measuring job requirements and in subsequently clustering the jobs.

The studies in this section, although differing in procedure, point to the feasibility of rating jobs on human attributes. Further, they demonstrate that it is possible to condense such ratings into meaningful dimensions. However, little if any validity data is available to judge the utility of these dimensions for the purposes discussed earlier (see p. 2)

With the exception of the study by Thorndike et al. (1957), the basic data for these studies were obtained from job analysts' estimates of the extent to which various human attributes are required in the performance of specified jobs. However, since attribute definitions are usually not directly relatable to observable events, such judgments require appreciable inference by the rater about the internal state of the worker. Since this is a particularly demanding task, it would seem preferable to define job elements in more readily observable terms.

Ratings of Jobs on Activity or Task Elements

A number of investigators have taken a more molecular but concrete approach to the derivation of work dimensions by using job ratings on statements of work activities and conditions. An early application of this approach is reported by Thomas (1952). In this study, a checklist of 139 basic clerical tasks was applied to a sample of 112 office positions. The checklist was administered to each job incumbent and his, or her, immediate supervisor with instructions to check the tasks performed on the job. Only 79 items, which were checked by 20 or more respondents, were retained for further analysis. Phi coefficients were then computed between all pairs of the surviving items, and the resulting correlation matrix was subjected to a cluster analysis. The analysis revealed eight clusters of clerical tasks, which were named as follows: (1) Typing, (2) Listing and Compiling, (3) Communication, (4) Planning and Supervision, (5) Filing, (6) Stock Handling, (7) Routine Clerical, and (8) Calculation. In his article, Thomas cautioned that because of the limitations of his sample, these clusters might not adequately represent the activity dimensions in the general population of office jobs.

In another study of clerical jobs, Chalupsky (1962) attempted to explore the basic dimensions underlying worker functions and knowledge requirements. Two checklists were developed for this purpose, one consisting of 33 clerical functions (e.g., analyzes, compiles, plans, and translates) and the other of 58 clerical knowledges (e.g., knowledge of operating an adding machine, etc.). The two checklists were then independently applied to a sample of 192 office jobs. The items in each checklist were intercorrelated and factor analyzed separately. Four factors emerged that were considered common to both checklists: Inventory and Stockkeeping, Supervision, Computation and Bookkeeping, and Communication and Public Relations. The knowledge checklist yielded two additional factors, Stenography-Typing and General Clerical, which taken together correspond to a fifth factor from the function checklist. Thus, the two analyses yielded quite similar results, even though each dealt with a different set of job variables. Furthermore, the factors identified in this study show a marked correspondence with the clusters of office operations previously noted by Thomas, indicating some stability in the dimensions identified for clerical jobs.

Hemphill (1959) summarized a research project undertaken by the Educational Testing Service (ETS) to identify and examine the basic dimensions underlying executive positions. The sample consisted of 93 executive positions from five different companies located throughout the United States and representing a wide range of management level and function. A comprehensive "executive position description" questionnaire containing 575 "position elements" was constructed and administered to incumbents with instructions to rate on an 8-point scale the extent to which each element was a "part" of the position in question. The position elements fell into four categories: (1) position activities (239 elements), (2) position responsibilities (189 elements), (3) position demands and

restrictions (84 elements), and (4) position characteristics (63 elements). The resulting data were subjected to an inverse inter-battery factor analysis (Tucker, 1958) which treated the 93 positions as variables and the 575 questionnaire items as observations. The analysis yielded 10 broad dimensions: (1) Staff service; (2) Supervision of work; (3) Internal business control; (4) Technical aspects of products and markets; (5) Human, community, and social affairs; (6) Long-range planning; (7) Exercise of broad power and authority; (8) Business reputation; (9) Personal demands; and (10) Preservation of assets. Hemphill suggests several areas of application for these 10 dimensions, including: promotion, organizational analysis, job rotation, performance appraisal, and salary administration.

Quite recently, Brumback and Vincent (1970) reported an attempt to derive work dimensions for a population similar to that investigated by Hemphill. The sample consisted of 3,719 Commission Corps Officers representing a wide range of administrative, professional, and scientific positions in the United States Public Health Service. The investigators constructed a rating instrument entitled "Position Inventory" which consisted of 196 "duty descriptions." Incumbents rated each duty on a 7-point scale in terms of its significance to their position. A principal components analysis of the 196 questionnaire items resulted in 26 clearly interpretable factors.

In discussing the use of activity elements for job analysis purposes, McCormick (1959) makes the distinction between "job-oriented" work activities and "worker-oriented" activities. By McCormick's definition, a job-oriented element is a description of a job operation in terms of what is accomplished (e.g., "bakes bread"), whereas a worker-oriented element describes what the worker actually does (e.g., "manually pours ingredients into container"). In this regard the author suggests that worker-oriented job activities are more suitable for describing a wide variety of jobs, since these activities, as opposed to job-oriented activities, are independent of the technological aspects of the jobs in which they occur.

In a study designed to implement the concept of worker-oriented job elements, Palmer and McCormick (1961) constructed a check list of 177 items describing various worker-oriented behaviors. These items were developed under the following categories: (1) Information-Receiving Activities, (2) Mental Activities, (3) Supervisory and Communication Activities, (4) Manual Activities, (5) General Body Activities, (6) General Work Conditions, and (7) General Job Characteristics. This instrument was used to rate a sample of 250 job descriptions representing the job structure of a large steel producing firm. The data analysis was performed in two stages. First, separate factor analyses were performed on the items comprising each of the first five categories indicated above. Fourteen factors emerged from these analyses. Factor scores were then derived for each job and these scores--along with the scores of 14 items measuring general work conditions, job characteristics, and educational development--were intercorrelated. A second factor analysis performed on the resulting

28 X 28 matrix revealed the following four factors: (1) General Decision Making and Mental Activity, (2) Sedentary vs. Physical Work Activity, (3) Communications in Business Management vs. Information in Routine Physical Work, and (4) Knowledge of Tools vs. Mathematics. The investigators concluded from the results that jobs can be described in terms of worker-oriented activity elements, and that a large number of jobs can be meaningfully organized in terms of a small number of relatively independent dimensions.

Encouraged by these findings, McCormick and his associates conducted a subsequent series of studies using worker-oriented job variables (Gordon and McCormick, 1963; Cunningham and McCormick, 1964; McCormick, Cunningham, and Gordon, 1967). The first phase of this project involved the development and application of the Worker Activity Profile (WAP), a job analysis instrument consisting of 162 worker-oriented job elements.

The WAP was used to rate two samples of jobs. One sample consisted of 400 jobs selected on the basis of proportions of jobs in the major occupational categories of the DOT. The other sample consisted of 371 jobs selected on the basis of proportions of people in the occupational categories. Data were collected through ratings of jobs from written job descriptions. Two series of factor analyses were conducted, consisting of six analyses for each sample. First, an overall analysis of 119 items was performed separately with each sample; then five additional analyses were made on the following subgroups of items: Mediation Activities, Physical Output Activities, Communication Activities, Situational Aspects, and Environmental Aspects. The factors resulting from these two series of analyses were compared using the coefficient of congruence (Tucker, 1951). These comparisons showed a substantial correspondence between the two independently derived factor structures. Of the 28 factors extracted from the first sample, 22 met the criteria for congruence with factors obtained from the second sample. This considerable correspondence between factors, despite the different bases of the samples, was presented as evidence of a stable factor structure. On the basis of these results, it was concluded that ". . . there is substantial 'structure' in the domain of human work as one looks at human work in terms of human behaviors and the contextual and environmental attributes of the work situation [1967, p. 429]." Nevertheless, the authors caution the reader to accept these dimensions as very tentative, pointing out that the WAP is an unfinished product with a number of "gaps and deficiencies."

Subsequent to the WAP studies, McCormick, Jeanneret, and Mecham (1969a, 1969b) constructed the Position Analysis Questionnaire (PAQ), a markedly improved job-analysis instrument consisting of 189 worker-oriented elements of both the rating scale and check list type. The items in the PAQ were organized into the following six categories: Information Input, Mediation Processes, Work Output, Interpersonal Activities, Work Situation and Job Context, and Miscellaneous Aspects.

The PAQ was then used in the collection of two different types of data. In one study (Mecham and McCormick, 1969), psychologists and graduate students in psychology assigned ratings on the "relevance" of 68 human attributes (aptitudes, temperaments, and interests) to each of 178 PAQ items. The average rating of 12-15 judges for a single attribute on a single PAQ item (or element) constituted an attribute-requirement estimate for that PAQ element; in this way, a profile of 68 attribute-requirement estimates was obtained for each PAQ element. In most cases, the reliabilities of the attribute weights exceeded .80, a level of reliability which Mecham and McCormick felt would justify the subsequent use of the PAQ in the investigation of aptitude and other attribute requirements of jobs.

The next phase of the PAQ research involved the derivation of basic job dimensions from the PAQ items (Jeanneret and McCormick, 1969). The investigators stated their rationale as follows: "It is hypothesized that there is some underlying 'structure' or order to the domain of human work, and that the variables that characterize this structure can be identified and dealt with in reasonably objective terms [p. 1]." In one part of this study, job analysts within 70 participating organizations rated a total of 536 jobs on the PAQ. The resulting data were then used in a series of seven factor analyses: an overall factor analysis of 150 PAQ items judged suitable for this purpose, and six separate factor analyses of items within the major divisions of the PAQ. Five factors emerged from the overall analysis: (1) Decision/ Communication/Social Responsibilities, (2) Skilled Activities, (3) Physical Activities/Related Environmental Conditions, (4) Equipment/ Vehicle Operation, and (5) Information Processing Activities. The six component analyses produced 27 interpretable factors. In order to test the stability of their factors, the investigators split their total sample of 536 jobs into two sub-samples of 268 jobs each. They then repeated the overall factor analysis of 150 items within both job samples, and compared factors across the two analyses using Tucker's (1951) coefficient of congruence. This comparison showed the two sets of factors to be ". . . highly congruent indicating substantial stability in the structure of the overall job dimensions [p. 90]."

A second set of factor analyses employed the previously described attribute-requirement weights of PAQ items as a data base. In these analyses, PAQ items were intercorrelated based upon their attribute-requirement profiles, and the resulting correlation matrices were factor analyzed. Separate factor analyses of items within the six major divisions of the PAQ resulted in a total of 21 factors which, though easier to interpret than the factors based upon job ratings, appeared somewhat similar to these factors. At this point, Jeanneret and McCormick (1969) noted that the relative merit of the two sets of factors (i.e., those based upon job ratings versus those based upon attribute ratings) was ". . . highly dependent upon the particular purpose for which the dimensions might be used, and should be the subject of further empirical investigation [p. 98]."

An attempt to identify work dimensions relevant to occupational education was reported by Sjogren, Schroeder, and Sahl (1967). Their review of the literature on job analysis, job evaluation, psychomotor behavior, and cognitive behavior revealed five major categories of work activities: physical, intellectual, discrimination, decision making and responsibility, and communication. A total of 42 activity items were defined within these five categories, and the following rating scales were developed for use with the items: Variety, Precision, Importance, Speed, Frequency, Complexity, and Strength. From four to seven of these scales were assigned to each of the 42 items; an analysis of a job on the items yielded over 200 separate scores. The instrument also included a check list of general work environment items, supervision items, clerical items, physical activities, and personal contact activities. In addition, certain scores from the DOT worker trait groups were obtained for each job, making a total of 329 scores per job for inclusion in subsequent data analyses. With the exception of the worker trait group scores, the data were collected through interviews with five or six job incumbents in each of 83 selected occupations in the agricultural and metal-working industries. A total of 466 incumbents were interviewed.

Three separate factor analyses were then performed on various item and trait scores. The factors which emerged corresponded to such an extent across the three analyses that the authors felt justified in concluding that ". . .the instrument was measuring behaviors that discriminated among occupations in a meaningful manner [p. 40]."

In a subsequent set of analyses, the mean score on each of the 329 variables was computed for each of the 83 occupations. These mean scores were intercorrelated and used to construct a matrix of the 47 agricultural occupations, a matrix of the 36 metal-working occupations, and a matrix of all 83 occupations. The factors extracted from separate analyses of these matrices were interpreted as clusters of jobs with similar behavioral requirements. The 83 X 83 matrix of intercorrelations among all occupations yielded four significant factors, defined as follows: an industrial work cluster, a business cluster, a production agriculture cluster, and a technical or skilled worker cluster. The behaviors characterizing each cluster (or factor) were identified by comparing the item scores of each job in the cluster with the mean item scores for the entire group of 83 jobs. A variable was defined as a behavioral characteristic of a cluster if a large proportion of jobs in the cluster scored above the mean on that variable. The results of these analyses showed commonalities among certain jobs existed across the two broad occupational categories. It is reported, for example, that ". . . occupations in the agriculture industry and agri-business clusters apparently exhibited more commonality of behavior with industrial or business occupations in metal-working than with production agriculture occupations [p. 82]." The investigators concluded that the study identified "reasonable" occupational clusters and that the results offer some implications for curriculum development.

The last study to be described in this review was reported recently by Bennett (1971), who hypothesized three basic dimensions of work: ". . . activities relating to ideas, to people, and to things [p. 230]." Following McCormick's conception of worker-oriented activities, the investigator compiled a list of 25 worker-oriented verbs of common usage. In addition, 10 task descriptions were prepared that were ". . . broadly representative of the expected factors and almost univer sally familiar [p. 230]." The 10 task descriptions and 25 verbs were then presented to 36 male college students with instructions to rate (on a 4-point scale) each verb in terms of its applicability to each task. Thus, 360 ratings were obtained for each verb: 36 ratings on each of 10 tasks. These data were used to obtain a matrix of correlations among the 25 verbs which, in turn, was subjected to a principal-components factor analysis. The four factors emerging from this analysis were defined as follows: (1) Cognitive, relating to ideas; (2) Social, relating to people; (3) Procedural, emphasizing equipment operation; and (4) Physical, consisting of basic physical activities. The first two factors were interpreted as correspondents to the hypothesized "idea" and "people" dimensions, whereas the Procedural and Physical factors were identified as constituents of the hypothesized dimension relating to things. Bennett concluded that his results partially confirmed the originally hypothesized dimensions.

The studies in this section of the review seem to have been less demanding upon their raters than the studies reviewed in previous sections. The statements of work activities and conditions employed in these studies should be easier to rate, since they are more closely related to observable events than are the human attribute definitions discussed earlier. On the other hand, rating jobs on attribute definitions might be easier than performing overall similarity ratings of jobs, since the latter task presumable requires the rater to take more information into account in making a single judgment. Furthermore, either activity or attribute ratings provide more information than overall similarity ratings, and both can be used to derive job similarity indices.

Studies employing statements of work activities and conditions can be divided into two groups: those using descriptors applicable to restricted ranges of jobs, and those whose descriptors are applicable to jobs in general (Cunningham, 1971). This latter category of variables is of particular interest for the purpose of the present study. Of the several efforts to develop work activity statements applicable to a broad spectrum of jobs, McCormick et al.'s Position Analysis Questionnaire has the longest research history and the strongest empirical support. Moreover, the PAQ has an added advantage in providing estimates of the human attribute requirements ofjobs, as well as descriptions of jobs in terms of work-dimension profiles. Accordingly, McCormick's work appears to provide a sound basis for the development of a job description and classification scheme applicable to educational problems.

PURPOSE

Although there have been a number of previous efforts to define and quantify dimensions of work, there remains a need for a comprehensive set of quantitatively based work dimensions which are: (1) general enough for application to a wide variety of jobs and occupations, yet specific and concrete enough to have curricular implications; (2) based upon current theories of human behavior; (3) linked to established human dimensions for which there are standardized measures (i.e., tests in the cognitive, psychomotor, and affective domains); and (4) empirically supported.

The Occupation Analysis Inventory (OAI) was designed with the above specifications in mind (Cunningham, Tuttle, Floyd, and Bates, 1971). In constructing the OAI, Cunningham and his associates have applied E. J. McCormick's procedures in an attempt to develop an instrument applicable to problems in occupational education. Whereas McCormick et al.'s Position Analysis Questionnaire (PAQ) was designed primarily for application to the problems of synthetic validity and job evaluation, the OAI is intended primarily for curricular and guidance purposes. For this reason, an effort was made to achieve as high a level of descriptive specificity (or content loading) in the OAI as possible, while maintaining its applicability to the entire spectrum of occupations. Accordingly, the OAI contains almost three times as many items as the PAQ, and some of these items are more "job-oriented," or technologically restricted, than the typical PAQ item.

The purpose of the present study was to derive a set of work dimensions (factors) from the 622 work elements (items) in the OAI. This was accomplished through the application of factor analytic procedures to the OAI ratings of a large, representative sample of jobs.

PROCEDURES

The procedures and statistical techniques involved in this study are described in the sections below.

Job Sample

A sample of 400 jobs was randomly selected in proportion to the numbers of jobs within the major occupational categories of the DOT. It was decided that analysts would rate from written job descriptions, rather than from direct, on-the-scene observation of the jobs. There were a number of reasons for this decision. First of all, it is much less expensive and time-consuming to use written job descriptions. Secondly, the convenient location and cooperative attitude of the local branch of the U. S. Employment Service (USES) made complete job analysis schedules easily accessible. (It is important to use comprehensive job descriptions in order to minimize the amount of information that has to be inferred by the rater). Thirdly, a study by Trattner et al. (1955) provides some evidence suggesting that ratings obtained from written job descriptions and from direct observation of the same jobs by professional job analysts are comparable. Finally, it was felt that some information slippage (as a result of using written job descriptions), though definitely undesirable, was nevertheless acceptable, since the primary concern of this study was not with specific jobs but with obtaining sufficient systematic variation on the OAI items to permit the extraction of stable factors.

Thus, the 400 descriptions for the selected sample of jobs were drawn from the USES files. In those cases where the desired job description was not available or was considered too brief, a job with the same, or as close to the same, DOT code number as possible was selected. These descriptions were then photocopied for subsequent use by the job analysts employed for this study. The procedure used in drawing the sample is described in detail in Appendix A. Table I summarizes the characteristics of the sampe. The complete list of jobs comprising the sample may be found in Appendix B.

Job Analysis Format

The data-gathering instrument used in this study is entitled the Occupation Analysis Inventory (Cunningham et al., 1970, 1971). Briefly, the inventory consists of 622 items (or work elements) grouped under five major categories:

1. Information Received
2. Mental Activities
3. Work Behavior
4. Work Goals
5. Work Context

Table 1. Numbers and percentages of jobs drawn from major occupational categories of the Dictionary of Occupational Titles, N = 400

Occupational Category	Number of Jobs in the Sample	Percentage of Job Sample
Professional, technical, and managerial occupations	50	12.50
Clerical and sales occupations	29	7.25
Service occupations	17	4.25
Farming, fishery, forestry, and related occupations	9	2.25
Processing occupations	87	21.75
Machine trades occupations	63	15.75
Bench work occupations	83	21.00
Structural work occupations	29	7.25
Miscellaneous occupations	33	8.25

These category headings represent the components of the closed-loop information-processing model (Figure 1) underlying the conceptual development of the OAI.

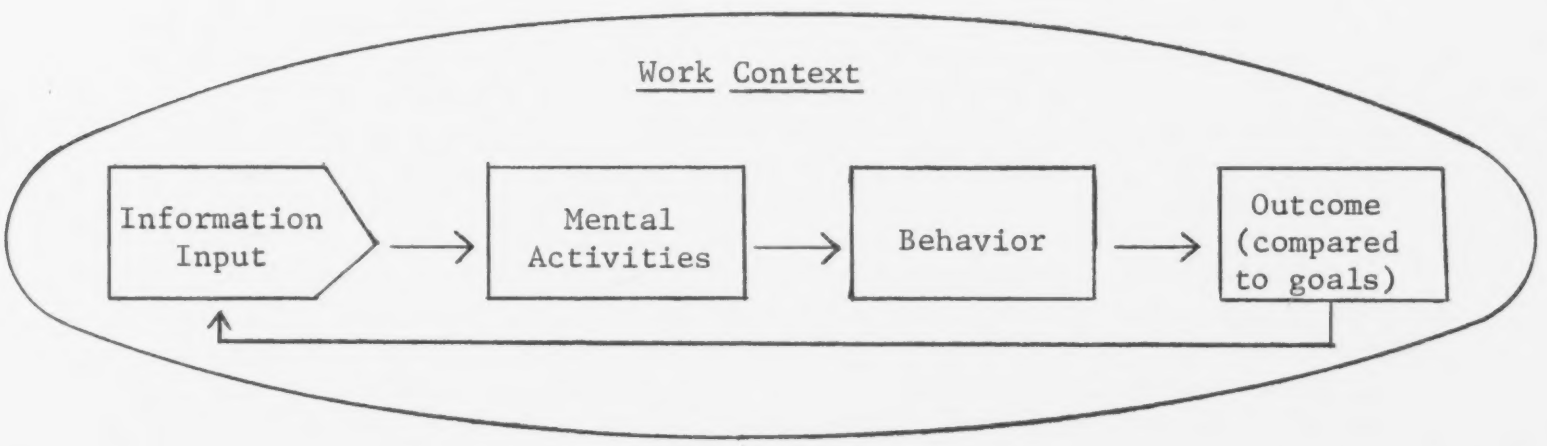

Figure 1. Information processing model

Three types of rating scales are employed in the OAI: a significance scale (0-5), an extent scale (0-5), and an applicability scale (0-1). The points on all three scales are marked by written descriptions. Each OAI work element is rated on one of these three scales or, in a number of instances, on a special scale designed for the particular work element.

Job Raters

Twelve USES job analysts and two graduate students were employed as raters in the study. Prior to any actual rating, a three-hour training session was held to familiarize the group with the OAI and to answer any questions concerning its use. The job analysts were paid on an hourly basis, and the graduate students were employed by the project as research assistants.

The 400 job descriptions were divided into twelve "books" (eight books containing 33 descriptions and four books with 34 descriptions), which were randomly distributed among the analysts. The jobs comprising each book were randomly selected to be proportionately representative of the entire sample. It was thus insured that each analyst would rate a wide range of jobs. Item ratings were recorded by circling the appropriate numbers on a nine-page response sheet. The ratings were collected over a seven-month period. The number of jobs rated by each analyst ranged from 14 to 68; the average time per job rating was approximately three hours.

As the ratings were collected, the response sheets were checked for omissions and then coded by analyst, job, and OAI section. The data were then punched onto IBM cards for subsequent analysis.

Reliability Estimates

Since the present study marked the initial application of the OAI as a job-analysis instrument, it was necessary that estimates of item reliability be determined. Four USES job analysts and two graduate research assistants were employed for this purpose. Four (of the original 12) books, containing a total of 134 job descriptions, were randomly selected as the reliability sample. Each of these books was rated independently either by two job analysts or by one job analyst and one graduate student on the OAI project. Thus, there were two independent ratings for each item on each of 134 jobs. Pearson product-moment correlation coefficients were determined for each item in three separate analyses. Table 2 provides a breakdown of the number of jobs and types of raters involved in each analysis. A complete list of the jobs employed in this phase of the study is presented in Appendix C.

Table 2. Breakdown of number of jobs and types of raters employed in the reliability analyses

Book Number	Number of Jobs	Raters[a] Group I	Raters[a] Group II
	Analysis 1		
4	33	J_1	J_2
11	34	J_3	J_4
	Analysis 2		
12	33	J_2	G_1
6	34	J_4	G_2
	Analysis 3		
4	33	J_2	J_1
12	33	J_2	G_1
11	34	J_3	J_4
6	34	G_2	J_4

[a] J stands for job analyst; G stands for graduate student.

The procedure was the same in all three analyses. Within each analysis, the raters were first split into two groups as shown in Table 2. Then, treating each group as a variable, the ratings of Group I were correlated with the ratings of Group II using the jobs common to both groups. Note, however, that the three analyses differ with respect to the raters employed and the jobs rated. Thus, the first analysis involved correlating the ratings of 67 jobs by two groups of professional job analysts, while the second analysis involved the ratings of a second set of 67 jobs by job analysts (Group I) and specially trained graduate students (Group II). It was assumed that a substantial agreement between the ratings of graduate students (having limited experience with job analysis procedures and the "world of work") and those of professional job analysts would lend support to the utilization of trained graduate students as raters in

subsequent research with the instrument. The third analysis involved all 134 jobs as well as all six raters employed in the first two analyses.

Factor Analyses

Pearson product-moment correlations were computed among the OAI work elements on the basis of job ratings. Since the total number of variables exceeded the limitations of the computer program, an overall factor analysis of the OAI could not be performed. However, seven separate factor analyses were conducted within the following sections of the OAI: (1) Information Received, (2) Mental Activities, (3) Physical Work Behavior, (4) Representational Work Behavior, (5) Interpersonal Work Behavior, (6) Work Goals, and (7) Work Context. The sections of the OAI dealing with Sensory Channel and Incentives (containing 10 and 17 items, respectively), as well as the five open-ended items in the Physical Work Behavior section, were excluded from the factor analyses.

Each factor analysis employed a principal components solution with unities in the diagonal of the correlation matrix. The "scree test" (Cattel, 1966) was used to determine the number of factors to retain from the unrotated matrices. This method aims at assuring the extraction of all true factor variance at the risk of including some error factor variance. The procedure involves constructing a two-dimensional graph with eigenvalues on the ordinate and factors numbered in order of extraction on the abscissa. Connecting the points plotted in this manner typically yields a curve which falls rapidly at first, but then levels off to become a straight line, or "scree," with only minor and irregular fluctuations. All factors lying along the scree line are assumed to be either error factors or factors with trivial non-error variance; those lying above the scree line are assumed to be substantive, or "real," factors. Therefore, to insure the extraction of all non-trivial common variance, the number of factors retained for rotation equals the number of factors lying above the scree plus the uppermost factor on the scree line.

Following the application of the procedure described above, factors were rotated obliquely to simple structure in each of the seven separate analyses (Gennrich and Sampson, 1966). Kaiser normalization was employed for this purpose. Factor scores were then computed for each job on each of the rotated factors. These scores will serve several purposes in future phases of the ergometric research program. In the present study, factor scores were employed to assist in the interpretation of the rotated factors, or work dimensions.

RESULTS OF THE RELIABILITY ANALYSES

The results of this phase of the study are, for the most part, encouraging. There were, however, a number of OAI work elements which were rated infrequently and thus displayed insufficient variation for the computation of meaningful correlation coefficients; consequently, these items were eliminated from the reliability analyses. An item was excluded from the reliability analyses if each of two raters did not assign at least two jobs values greater than zero on the item, and if these ratings were not distributed into at least two levels on the scale for that item.

Table 3 presents a frequency distribution of item reliabilities obtained from the third reliability analysis (N = 134 jobs), described on page 19. It should be noted that this distribution compares rather

Table 3. Frequency distribution of inter-rater reliability coefficients of 512 items of the Occupation Analysis Inventory applied to 134 jobs [a,b]

Reliability Coefficient	Frequency	Proportion	Cumulative Proportion
.91 - 1.00	14	.027	1.000
.81 - .90	36	.070	.973
.71 - .80	82	.160	.903
.61 - .70	104	.203	.743
.51 - .60	90	.176	.540
.41 - .50	68	.133	.364
.31 - .40	56	.110	.231
.21 - .30	23	.045	.121
.11 - .20	18	.035	.076
.01 - .10	7	.014	.041
-.09 - .00	14	.027	.027

[a]Items having insufficient variation were omitted.

[b]Correlations of .22 are significant at the .01 level.

closely with the distribution obtained for the Worker Activity Profile by Gordon and McCormick (1963), which is not surprising in view of the similarities between the two instruments (i.e., the WAP and the OAI), rating procedures, and procedures for determining item reliabilities employed in both studies. These results are somewhat encouraging, since they indicate that the reliabilities of the OAI items are as high as those obtained under similar circumstances for other job-rating inventories. Moreover, there are two reasons why these reliabilities might be considered lower-bound estimates. First, as Gordon points out, when reliability coefficients are computed between groups of job raters rather than between single raters, systematic differences among raters within the groups reduce the correlation between the groups. Thus, these reliabilities should be considered ". . . underestimates to the extent that different raters within a group had different rating 'sets' [p. 13]." Second, there is some evidence that job-rating reliabilities are higher when based on actual job obervation and experience rather than on written descriptions (Jeanneret and McCormick, 1969).

Table 4 presents the frequency distributions of item reliability coefficients obtained from the first and second analyses--i.e., (1) correlations between two groups of professional job analysts and (2) correlations between professional job analysts and specially trained graduate students. It can be seen from these distributions that the agreement between the ratings of graduate students and job analysts (Analysis 2) was as high as the agreement between two groups of job analysts (Analysis 1).

Table 4. Frequency distributions of OAI item reliabilities obtained from reliability analyses 1 and 2[a]

	Analysis 1[b]		Analysis 2[c]	
Reliability Coefficient	Frequency	Proportion	Frequency	Proportion
.91 - 1.00	9	.021	27	.061
.81 - .90	25	.058	60	.135
.71 - .80	55	.128	71	.160
.61 - .70	72	.167	71	.160
.51 - .60	67	.156	69	.155
.41 - .50	63	.147	53	.119
.31 - .40	47	.109	33	.074
.21 - .30	34	.079	19	.043
.11 - .20	26	.060	10	.023
.01 - .10	11	.026	12	.027
-.09 - .00	21	.049	19	.043
Total	430		Total 444	

[a]Items having insufficient variations were omitted.

[b]Reliabilities based on correlations between ratings of two groups of professional job analysts.

[c]Reliabilities based on correlations between ratings of professional job analysts and graduate students.

RESULTS OF THE FACTOR ANALYSES

There are 622 work elements items comprising the OAI. As indicated earlier, however, not all of these items were included in the factor analyses. In addition to those items previously noted, a number of other items had to be eliminated as a result of the reliability analyses. Specifically, it was decided to include for factor analysis only those items which had reliability coefficients of .22 or greater ($p < .01$) and which received a minimum spread of ratings (see p. 21). Consequently, a total of 177 items were excluded from the factor analyses. (A complete list of these items is shown in Appendix D.) The remaining 445 items were included in the seven sectional factor analyses as follows: (1) Information Received (90 items); (2) Mental Activities (38 items); (3) Physical Work Behavior (135 items); (4) Representational Work Behavior (32 items); (5) Interpersonal Work Behavior (25 items); (6) Work Goals (78 items); and (7) Work Context (47 items). Each of these analyses was conducted using the factor analysis and rotation techniques described earlier.

Correlations between factors within each of the seven analyses are shown in Appendix E. The work dimensions which were derived from the seven sectional factor analyses are presented in Tables 5 through 11. According to Guilford (1954), factor loadings greater than .25 to .30 are "substantial"; thus, only those work elements with loadings of .30 or higher were included in these tables. In the sections which follow, each dimension (factor) will be described separately in terms of those items for which it has substantial loadings. To assist in these interpretations, examples of jobs which received high factor scores on each dimension are also presented.

Dimensions of Information Received

The principal components analysis of the work elements comprising the Information Received section of the OAI resulted in 17 factors which accounted for 72 percent of the total variance. As shown in Table 5, all but one of these dimensions lent themselves to meaningful interpretation.

Dimension A-1: Technical written information. All but two of the work elements having substantial loadings on this factor emphasize written information, particularly of a technical nature. This emphasis is apparent in the types of jobs which received high scores on this dimension. Included among those jobs were: precision assembly mechanic, tool designer, production engineer, maintainability design engineer, and nuclear engineer.

Dimension A-2: Clerical information. The work elements characterizing this dimension are concerned with information relevant to clerical activities. Thus, some of the jobs which received high scores on this factor were: correspondence clerk, transcribing machine operator, administrative assistant, sports editor, bookkeeping machine operator, and order clerk.

Dimension A-3: Electrical/electronic information. This dimension emphasizes both direct and indirect information pertaining to electrical/electronic devices and systems. All of the items having substantial loadings on this factor except one, Conductivity (Item 45i), are contained in the OAI section entitled Electrical and Electronic Information. The jobs of electrician and electrical engineer received highest scores on this factor.

Dimension A-4: Environmental information. This dimension corresponds closely to the OAI section of the same title. The items loading on it deal with direct and indirect information pertaining to the outdoor environment. Examples of jobs which received high scores on this dimension include: forester aide, hydrologist, grass farmer, and surveyor.

Dimension A-5: Information concerning mechanical devices/processes. This dimension emphasizes both direct and indirect information concerning the functioning of mechanical systems. The item loadings suggest, however, that the primary concern is with the operation, maintenance, and repair of such devices. Jobs receiving high factor scores on this dimension include: Turret-lathe operator, honing machine operator, horizontal boring-mill operator, auto mechanic, boat mechanic, propellant-and-gas mechanic, and maintenance mechanic.

Dimension A-6: Information concerning the physical aspects of people. The items characterizing this dimension deal with information relevant to the physical condition, appearance, and performance of people. This is also reflected by the jobs receiving high factor scores on this dimension. These jobs include nurse, nurse's aide, and physical therapist.

Table 5. Dimensions of Information Received

	Work Dimension	Rotated Loading[a]
Dimension A-1:	Technical written information.	
12i	Written material pertaining to mechanical or physical principles	.59
32i	Written material pertaining to basic principles of structures	.50
49i	Technical written material concerning physical or chemical properties of materials or substances	.49
11i	Written material pertaining to mechanical devices	.41
8i	Mechanical drawings	.39
10i	Mechanical test equipment and measuring devices	.39
23i	Written material pertaining to basic principles of electricity/electronics	.39
22i	Written material pertaining to electrical devices	.34
31i	Written material pertaining to interrelated parts and objects	.32
Dimension A-2:	Clerical information.	
83i	Proper classification	.84
80i	Correspondence of contents of one manuscript or list with contents of another	.80
81i	Format, punctuation, or spelling	.72
82i	Grammar or expression	.60
91i	Verbal information	.31
Dimension A-3:	Electrical/electronic information.	
16i	Malfunctions of specific electrical/electronic parts or components	.89
15i	Interrelations or interconnections of electrical or electronic parts	.87
21i	Electrical/electronic test equipment and measuring devices	.86

Table 5 (continued)

	Work Dimension	Rotated Loading[a]
Dimension A-3: Continued.		
19i	Electrical/electronic symbols and codes	.85
13i	Overall performance or electrical/electronic devices in relation to standards	.83
20i	Displays conveying electrical/electronic information	.82
18i	Electrical/electronic schematics and diagrams	.80
14i	State of preventive maintenance	.78
17i	Regulation and control of electrical and electronic systems	.75
22i	Written material pertaining to electrical or electronic devices	.75
23i	Written material pertaining to basic principles of electricity/electronics	.73
45i	Conductivity	.66
Dimension A-4: Environmental information.		
56i	Environmental emergencies	.89
51i	Soil	.84
50i	Plant life	.82
59i	Tables and graphs	.80
57i	Charts or maps	.72
53i	Water conditions	.71
52i	Terrain and geological features	.70
55i	Weather and atmospheric conditions	.70
Dimension A-5: Information concerning mechanical devices/processes.		
1i	Overall state of mechanical information	.90
4i	Malfunction of specific parts or components	.90
5i	Control or regulation of mechanical devices	.85
3i	State of preventive maintenance	.84

Table 5 (continued)

	Work Dimension	Rotated Loading[a]
Dimension A-5: Continued.		
7i	Mechanical motion	.84
6i	Interrelations of mechanical parts	.82
2i	Quantity and quality of machine output in relation to standards of performance or quality control standards	.77
9i	Displays	.67
11i	Written material pertaining to mechanical devices	.46
10i	Mechanical test equipment and measuring devices	.43
8i	Mechanical drawings	.37
Dimension A-6: Information concerning the physical aspects of people.		
101i	Physical condition of people	.77
102i	Grooming, style, and poise of people	.71
107i	Mood, attitudes, feelings, intentions, desires, etc.	.69
112i	Descriptions of individuals	.69
109i	Emergency situations involving people	.62
70i	State of health or hygiene	.61
73i	Materials and devices related to biology or health	.61
104i	Physical performance of people	.60
91i	Verbal information	.30
Dimension A-7: Information concerning the chemical properties of materials.		
48i	Nontechnical written material pertaining to materials or substances	.67
47i	Symbol systems pertaining to materials or substances	.66
46i	Materials measuring and testing devices	.63

Table 5 (continued)

	Work Dimension	Rotated Loading[a]
Dimension A-7: Continued.		
44i	Chemical reactivity	.59
37i	Physical state	.49
49i	Technical written material concerning physical or chemical properties of materials or substances	.42
92i	Numerical or coded information	.39
Dimension A-8: Art/decorative information.		
63i	Location of objects or people in space for aesthetic purposes	.84
61i	Colors and color schemes	.83
62i	Form or shape of objects	.70
27i	Interrelation or arrangement of unconnected objects within a prescribed space or area	.65
29i	Drawings, patterns, or diagrams pertaining to the layout or placement of unconnected parts or objects	.50
Dimension A-9: Direct sales information.		
93i	Money or other medium of exchange	.88
94i	Merchandise	.80
96i	Customers and clients	.77
95i	Advertising materials	.72
100i	Contracts and other legal written information	.42
97i	Numerical business information	.37
91i	Verbal information	.32
Dimension A-10: Unnamed.		
40i	Malleability/ductility	-.32
55i	Weather and atmospheric conditions	-.36

Table 5 (continued)

	Work Dimension	Rotated Loading[a]
Dimension A-10: Continued.		
115i	Tables, diagrams, graphs, etc., conveying information about people	-.48
43i	Hazard (materials)	-.60
Dimension A-11: Spatial/structural information.		
24i	Interrelation, position, and fit of connected parts or objects	.82
25i	Connections and fastening of objects and parts	.82
26i	Appearance of assembled or constructed objects in relation to prescribed standards	.81
28i	Drawings, plans, or diagrams pertaining to the arrangement, placement, and fastening of interconnected parts	.56
31i	Written material pertaining to interrelated parts and objects	.51
30i	Measuring and layout devices	.43
32i	Written material pertaining to basic principles of structures	.42
Dimension A-12: Information about groups of people.		
81i	Format, punctuation, or spelling	-.33
115i	Tables, diagrams, graphs, etc., conveying information about people	-.46
82i	Grammar or expression	-.52
113i	Characteristics of groups of people and people in general	-.60
106i	Knowledge, verbal information, and experience	-.64
111i	Group settings	-.66

Table 5 (continued)

	Work Dimension	Rotated Loading[a]
Dimension A-13:	Information concerning nutrition.	
69i	Dietary needs or deficiences	.81
74i	Materials, objects, and devices related to nutrition, sanitation, or food preparation	.81
70i	State of health and hygiene	.55
Dimension A-14:	Indirect business/sales information.	
98i	Business graphs, charts, or diagrams	.77
97i	Numerical business information	.56
99i	Written business information	.54
100i	Contracts and other legal written information	.32
40i	Malleability/ductility	-.37
Dimension A-15:	Information pertaining to physical arrangement and layout.	
29i	Drawings, patterns, or diagrams pertaining to the layout or placement of unconnected parts or objects	.54
100i	Contracts and other legal written information	.41
37i	Physical state	.38
57i	Charts or maps	.34
27i	Interrelation or arrangement of unconnected objects within a prescribed space or area	.33
52i	Terrain and geological features	.32
Dimension A-16:	Numerical/graphic information.	
86i	Frequency of numerical information	.79
84i	Complexity of numbers	.78
85i	Signs and symbols representing numerical operations and relations	.71
89i	Diagrams, drawings, or maps	.61

Table 5 (continued)

Work Dimension		Rotated Loading[a]
Dimension A-16: Continued.		
79i	Content or meaning	.57
87i	Tables and graphs	.42
30i	Measuring and layout devices	.36
8i	Mechanical drawings	.31
46i	Materials measuring and testing devices	.30
Dimension A-17: Information concerning the quality of materials.		
39i	Consistency	.67
34i	Surface characteristics	.65
33i	Overall quality	.64

[a]Rotated loadings less than .30 were omitted.

Dimension A-7: Information concerning the chemical properties of materials. This dimension is concerned with direct and indirect information relating to the chemical properties of materials. Among those jobs receiving high scores on this factor are pharmacist, microbiologist, bio-instrumentation technician, pulp bleacher man, polymerization foreman, chemical operator, and propellant-and-gas mechanic.

Dimension A-8: Art/decorative information. This dimension emphasizes a concern with information of an aesthetic nature derived from the arrangement of objects or people in space, colors and color schemes, and the form or shape of objects. Examples of jobs receiving high factor scores on this dimension include: illustrator, cloth designer, display man, executive housekeeper, and salesperson (men's furnishings).

Dimension A-9: Direct sales information. This dimension is composed of items which deal with sales and business information, with the main emphasis on the sales aspect. Moreover, the input seems to be derived primarily through direct contact with customers, merchandise, etc. This interpretation is supported by an examination of the types of jobs which received high scores on this factor. In addition to a variety of sales positions, these jobs included sales manager, store manager, and journeyman groceryman.

Dimension A-10: Unnamed. The diversity of items which comprise this dimension prevents any meaningful interpretation. However, there appears to be some involvement with hazardous environmental materials. Examples of jobs which received high factor scores on thie dimension include: bio-instrumentation technician, tests superintendent (light, heat, and power), market-research analyst, petroleum production engineer, fisherman, and public utilities commissioner.

Dimension A-11: Spatial/structural information. This dimension is characterized by work elements which convey both direct and indirect information pertaining to the interrelationships of connected objects and parts. All of the items loading on this dimension are contained within the section of the OAI entitled Spatial/Structural Information. Some of the jobs with high scores on this dimension include: maintainability design engineer, nuclear engineer, maintenance pipe fitter, detail draftsman, and bracket mounter.

Dimension A-12: Information about groups of people. This dimension emphasizes information pertaining to the behavior of groups of people or people in general. All but two of the elements loading on this factor are contained in the OAI section entitled Information About People and Animals. Examples of jobs receiving high scores on this factor include: market-research analyst, personnel representative, college professor, and sales manager.

Dimension A-13: Information concerning nutrition. Although there are only three elements loading on this factor, they reflect a rather clear concern with information pertaining to nutrition and

the dietary needs of people. The jobs with the highest scores on this dimension were nurse, catering manager, and cook.

Dimension A-14: Indirect business/sales information. In contrast to Dimension A-9 (Direct sales information), this factor deals with indirect business information derived from written verbal and numerical material, graphs, charts, etc. Although item 40i (Malleability/ductility) received a substantial negative loading, as opposed to the positively loading items characterizing this dimension, neither the magnitude of the loading nor the nature of the element seemed to justify a bipolar interpretation. Examples of jobs receiving high scores on this dimension include: market-research analyst, administrative assistant, technical reporting analyst, accountant, and sales manager.

Dimension A-15: Information pertaining to physical arrangement and layout. Although this dimension is not very clearly defined by the elements which comprise its structure, there does appear to be a concern with information pertaining to the physical arrangement of objects (e.g., from drawings, charts, maps, and terrain features). This interpretation is consistent with the types of jobs which received high scores on the factor. These jobs include surveyor, nuclear engineer, and production superintendent (wood preserving).

Dimension A-16: Numerical/graphic information. The items characterizing this dimension concern information of both a numerical and graphic nature; although the three items with the highest loadings deal with numerical information, this factor also includes work elements concerned with diagrams, graphs, drawings, and measuring devices. Jobs receiving high factor scores on this dimension include maintainability design engineer, spectroscopist, production engineer, plaster patternmaker, and electronic engineer.

Dimension A-17: Information concerning the quality of materials. This dimension is similar to Dimension A-7 (Information concerning the chemical properties of materials) in its concern with the properties of materials. However, here the emphasis seems to be on the quality of the materials, particularly with respect to their visual or tangible characteristics. Examples of jobs which received high scores on this dimension include: gemologist, record press foreman, finish inspector-instructor (pottery and porcelain), organic chemist, and dental ceramist.

Dimensions of Mental Activities

The component analysis of the OAI work elements comprising the Mental Activities section produced seven factors which explained 69 percent of the total variance. All of these dimensions were interpreted and are presented in Table 6.

Table 6. Dimensions of Mental Activities

	Work Dimension	Rotated Loading[a]
Dimension B-1:	Semantic planning and problem solving.	
24m	Problem detection	.68
34m	Plan elaboration	.67
38m	Group perception	.66
23m	Problem comprehension	.64
29m	Plan ordering	.62
28m	Deductive reasoning	.55
41m	Work experience	.55
25m	Memory of unitary ideas	.40
37m	Person perception	.39
31m	Idea production	.38
26m	Memory of idea sequences	.37
32m	Idea expression	.34
33m	Idea flexibility	.30
Dimension B-2:	Figural perception and problem solving.	
7m	Figural problem solving	.81
6m	Figural memory	.77
9m	Form perception	.69
4m	Object visualization	.66
5m	Visual tracing	.44
2m	Object discovery	.41
29m	Plan ordering	.39
22m	Verbal comprehension	.37
15m	Numerical computation	.32
Dimension B-3:	Figural creativity.	
10m	Aesthetic judgment	.92
8m	Figural ingenuity	.61

Table 6 (continued)

	Work Dimension	Rotated Loading[a]
Dimension B-3: Continued.		
30m	Idea originality	.61
33m	Idea flexibility	.35
4m	Object visualization	.30
Dimension B-4: Symbolic thinking and problem solving.		
19m	Symbolic generation	.84
13m	Symbolic induction	.77
16m	Symbolic deduction	.71
21m	Evaluation of symbolic procedures	.70
17m	Symbolic operations sequencing	.64
28m	Deductive reasoning	.53
12m	Comprehension of symbolic procedures	.49
8m	Figural ingenuity	.38
31m	Idea production	.35
33m	Idea flexibility	.30
Dimension B-5: Routine semantic and symbolic activities.		
20m	Clerical perception	.86
11m	Spelling	.79
15m	Numerical computation	.50
39m	Educational level	.45
22m	Verbal comprehension	.44
36m	Verbal construction	.40
12m	Comprehension of symbolic procedures	.38
Dimension B-6: Spatial orientation.		
3m	Spatial orientation	.75
39m	Educational level	.37

Table 6 (continued)

Work Dimension		Rotated Loading[a]
Dimension B-6: Continued.		
41m	Work experience	.37
40m	Job-related preparation	.30
Dimension B-7: Semantic facility and originality.		
32m	Idea expression	-.33
30m	Idea originality	-.35
38m	Group perception	-.40
33m	Idea flexibility	-.43
22m	Verbal comprehension	-.43
37m	Person perception	-.46
36m	Verbal construction	-.62
18m	Word fluency	-.72
35m	Associational fluency	-.73

[a]Rotated loadings less than .30 were omitted.

Dimension B-1: Semantic Planning and Problem Solving. The first factor emerging from this section concerns the use of semantic information in planning and problem solving. According to Guilford (1967), "Semantic information is in the form of meanings to which words commonly become attached; hence, it is most notable in verbal thinking and verbal communication [p. 227]." Semantic Planning and Problem Solving is often associated with administrative, managerial, and supervisory positions, and this is reflected in the types of jobs receiving high scores on this factor. Among these were: warehouse manager, catering manager, production superintendent, tests superintendent, assembly foreman, polymerization foreman, plate manufacturing foreman, production department foreman, refill assembly foreman, and public utilities commissioner. The signifiloadings on Items 37m, 38m, and 41m are consistent with this interpretation, since managerial jobs require experience and involve contact with people.

Dimension B-2: Figural Preception and Problem Solving. This factor emphasizes a number of activities which involve the processing of information pertaining to "things." These activities can be divided into two groups: (1) basic perceptual activities (Items 2m, 4m, 5m, 6m, and 9m), and (2) problem-solving activities (Items 7m and 29m). The significant loadings on Verbal Comprehension (Item 22m) and Numerical Computation (Item 15m) suggest at least a minimum requirement for basic intellectual skills. Examples of jobs receiving high scores on this factor include: detail draftsman, precision assembly mechanic, chief pilot, college faculty member, horizontal boring-mill-set-up operator, electrical aircraft mechanic, maintenance pipe fitter, and tool designer.

Dimension B-3: Figural Creativity. The pattern of loadings on this factor suggests a dimension of visual-figural creativity. According to Guilford (1967), "Figural information is in concrete form, as perceived or as recalled in the form of images . . . . In the visual area, we encounter such properties as color, shape, texture, size, continuity, and dimensionality [p. 22]." Aesthetic Judgment (Item 10m) has the highest loading on this factor, accompanied by significant loadings on three divergent-production items (Items 8m, 30m, and 33m), and a low but significant loading on Object Visualization (Item 4m). This interpretation is further supported by the jobs receiving high scores on this dimension. Among these jobs were: cloth designer, illustrator, gemologist, hair stylist, detail draftsman, production engineer, silver saleslady, display man, and store manager.

Dimension B-4: Symbolic Thinking and Problem Solving. Guilford defines symbolic information as ". . . information . . . in the form of signs, materials, the elements having no significance in and of themselves, such as letters, numbers, musical notations, and other 'code' elements [1967, p. 227]." This factor emphasizes a variety of symbolic information-processing activities which are typically associated with technical and professional work. These activities involve both convergent and divergent symbolic thinkings, as well as the cognition and evaluation of symbolic information. In addition, one figural and two semantic divergent-thinking items have low but significant loadings. Jobs receiving high scores on this factor included: university faculty member, organic chemist, pharmacist, nuclear engineer, microbiologist, detail draftsman, senior communications electrician, production engineer, surveyor, bio-instrumentation technician, tests superintendent, and hydrologist.

Dimension B-5: Routine Semantic and Symbolic Activities. The items comprising this factor deal with verbal and numerical activities of a routine, or clerical, nature. Examples of jobs receiving high scores on this factor include: correspondence clerk, credit supervisor, bookkeeping-machine operator, transcribing-machine operator, personnel services coordinator, pharmacist, superintendent of schools, electrical aircraft mechanic, collator, and sports editor.

Dimension B-6: Spatial Orientation. One variable, Spatial Orientation, clearly predominates in this factor. This item involves visually perceiving the arrangement of objects in space using oneself as a frame of reference. The other three items marking this dimension deal with the education and job-related experience required of the worker and have substantially lower loadings. Two of these later items, Work Experience (Item 41m) and Job-Related Preparation (Item 40m), seem consistent with the Spatial Orientation item. Jobs receiving high scores on this dimension include: electronic engineer, electrician, hand polisher (instrument and appliance), chief pilot, senior communications electrician, utility man (flooring), foundrinier-machine tender, boat mechanic, and powerline repairman.

Dimension B-7: Semantic Facility and Originality. With the exception of two items, the variables characterizing

this dimension deal with semantic information processing. The semantic items seem to fall into two categories: (1) activities suggesting verbal facility (Items 18m, 22m, 32m, 35m, and 36m) and (2) activities associated with semantic originality (Items 30m and 33m). The significant loadings on Person and Group Perception (Items 37m and 38m) also indicate some direct involvement with people, although this would appear to be incidental in the interpretation of the factor. In summary, this dimension involves language facility and ideational originality, two seemingly complementary attributes. An examination of the jobs receiving high factor scores helps clarify this interpretation. These jobs included: personnel services coordinator, microbilogist, college faculty member, illustrator, superintendent of schools, catering manager, natural history museum curator, nuclear engineer, production department foreman, personnel representative, and bridge instructor.

Dimensions of Physical Work Behavior

A component analysis of the work elements within the Physical Work Behavior section of the OAI yielded 17 dimensions which accounted for 45 percent of the total variance. All of these dimensions were interpreted and are presented in Table 7.

Dimension C-1: Maintenance and repair activities. This dimension emphasizes maintenance and repair of electrical and mechanical equipment. Examples of jobs receiving high factor scores on this dimension include: electrician, bio-instrumentation technician, factory maintenance man, automobile mechanic, and precision assembly mechanic.

Dimension C-2: Mechanized equipment operation. The work elements comprising this dimension involve the operation of mechanized equipment and related physical activity requirements (e.g., reaction time, tracking, multilimb coordination, etc.). Also loading on this dimension are items pertaining to the use of both discrete and continuous controls and settings. Among the jobs receiving high scores on this factor are crane operator, log stacker operator, power-shovel operator, and scraper operator.

Dimension C-3: General physical vs. sedentary activities. This dimension emphasizes a wide range of physical activities requiring both strength and coordination. The presence of a rather high positive loading on item 15a (Sitting)--contrasted with the negative loading of the remaining items--suggests that this factor should be interpreted as having a bipolar structure.

Dimension C-4: Combining/separating processed materials. This dimension emphasizes the combining and separating of processed materials, particularly chemicals, including related measurement and monitoring activities. Jobs receiving high scores on this dimension

Table 7. Dimensions of Physical Work Behavior

	Work Dimension	Rotated Loading[a]
Dimension C-1: Maintenance and repair activities.		
30a	Diagnosing/troubleshooting	.78
87t	Electrical (electrical devices)	.75
32j	Electrical/electronic equipment and components	.70
27a	Repairing	.68
29a	Adjusting/tuning	.64
50a	Testing	.54
28a	Servicing	.53
23j	Electrical and electronic parts and components	.50
32a	Installing/connecting	.42
31j	Machines and mechanical components, excluding transportation and mechanized equipment	.39
7t	Stitching/wiring (non-powered)	.31
13a	Climbing	.31
26t	Fusion (portable powered)	.30
Dimension C-2: Mechanized equipment operation.		
7a	Reaction time	.75
83t	Hand-operated (continuous controls)	.73
26a	Driving/operating (machine related)	.73
3a	Tracking	.67
81t	Hand-operated (discrete controls)	.63
8a	Multilimb coordination	.60
67t	Heavy equipment (mechanized equipment)	.59
2a	Control precision	.57
84t	Foot-operated (continuous controls)	.52
*	Ear-hand or ear-foot coordination	.51
82t	Foot-operated (discrete controls)	.44
30j	Transportation and mechanized equipment	.35
70t	Medium/light highway vehicles	.31

Table 7 (continued)

	Work Dimension	Rotated Loading[a]
Dimension C-3:	General physical vs. sedentary activities.	
15a	Sitting	.54
13a	Climbing	-.30
8a	Multilimb coordination	-.33
15t	Cleaning (non-powered)	-.36
43a	Cleaning	-.36
20a	Explosive strength	-.37
43t	Supporting (portable non-powered)	-.38
5a	Manual dexterity	-.45
45t	Non-powered wheeled equipment (portable)	-.46
11a	Walking	-.49
9a	Balance	-.51
14a	Standing	-.52
18a	Finger/hand/arm strength	-.52
16a	Kneeling/stooping/crawling	-.53
44a	Material and object handling	-.54
10a	General body coordination	-.59
21a	General body strength	-.65
Dimension C-4:	Combining/separating processed materials.	
39a	Combining/separating (material modifying)	.75
64t	Combining/separating (stationary machines and equipment)	.70
14j	Chemical and petroleum materials and substances	.56
85t	Weight/volume (measurement)	.50
88t	Pressure/temperature (measurement)	.44
47a	Monitoring	.37
90t	Motion/force (measurement)	.30
93t	Optical devices (measurement)	.30

Table 7 (continued)

	Work Dimension	Rotated Loading[a]
Dimension C-5: Stationary material-removing machine operation.		
65t	Handling/supporting (stationary machines and equipment)	-.35
22j	Mechanical parts	-.38
92t	Work layout	-.39
42t	Holding (portable non-powered)	-.42
25a	Operating/controlling (machine related)	-.42
79t	Hand-operated (continuous settings)	-.46
60t	Grinding (stationary machines and equipment)	-.55
36a	Material shaping	-.61
84t	Foot-operated (continuous controls)	-.63
59t	Shaping (stationary machines and equipment)	-.66
58t	Drilling/perforating (stationary machines and equipment)	-.68
9j	Metal, excluding precious metals	-.68
Dimension C-6: Sewing, stitching, and related activities.		
54t	Stitching, knitting, and weaving (stationary machines and equipment)	.88
35a	Fiber/thread working	.81
2t	Cutting by shearing (non-powered)	.61
27j	Textile, leather, and related synthetic parts	.60
84t	Foot-operated (continuous controls)	.55
7t	Stitching/wiring (non-powered)	.33
25a	Operating/controlling (machine related)	.33
Dimension C-7: Preparation/modification of surfaces.		
9t	Abrading/polishing (non-powered)	.71
38a	Surface finishing	.66
4t	Cutting by abrasion (non-powered)	.60

Table 7 (continued)

Work Dimension		Rotated Loading[a]
Dimension C-7: Continued.		
57t	Abrading (stationary machines and equipment)	.57
12t	Shaping (non-powered)	.48
10t	Scraping (non-powered)	.40
44j	Heat or pressure treating, except in forming	.40
49a	Inspecting	.32
Dimension C-8: Heat and chemical treatment.		
42a	Heat or pressure treating, except in forming	.73
62t	Heat application (stationary machines and equipment)	.71
40a	Chemically treating	.52
24a	Tending (machine related)	.48
75t	Material conveyors	.43
56t	Liquid application/coating (stationary machines and equipment)	.42
88t	Pressure/temperature (measurement)	.36
77t	Hand-operated (continuous settings)	.34
Dimension C-9: Joining/attaching.		
5t	Bonding/sealing (non-powered)	.61
31a	Laying/covering	.60
33a	Constructing/building	.42
34j	Equipment/systems, not elsewhere defined	.42
32a	Assembling	.32
43j	Apparel and finished textile and leather products	.32

Table 7 (continued)

	Work Dimension	Rotated Loading[a]
Dimension C-10: Cutting/processing food materials.		
43a	Cleaning	-.35
47t	Cutting by sawing (stationary machines and equipment)	-.39
1t	Cutting by sawing (non-powered)	-.48
19j	Processed foods, which require further preparation	-.52
50t	Cutting by blade (stationary machines and equipment)	-.56
3t	Cutting by blade (non-powered)	-.59
7j	Non-processed or minimally-processed animal materials	-.63
Dimension C-11: Precision assembling.		
34a	Assembling	.65
26t	Fusion (portable powered)	.59
4a	Finger dexterity	.51
1a	Eye-hand coordination	.46
41t	Degree of precision in portable powered tool/equipment usage	.41
46a	Precision working	.38
5a	Manual dexterity	.35
42t	Holding (portable non-powered)	.32
20t	Degree of precision in hand tool usage (non-powered)	.30
Dimension C-12: Plant and animal care.		
16t	Earth working (non-powered)	.51
1j	Plant life	.50
2j	Animals and marine life	.40
21t	Cutting by sawing (portable powered)	.38
85t	Weight/volume (measurement)	.32

Table 7 (continued)

	Work Dimension	Rotated Loading[a]
Dimension C-13: Cutting/modifying wood and related materials.		
36a	Material shaping	-.34
6j	Non-processed woods	-.38
47t	Cutting by sawing (stationary machines and equipment)	-.43
10j	Lumber and related materials	-.52
Dimension C-14: Material forming.		
37a	Material forming	.76
61t	Forming (stationary machines and equipment)	.71
12j	Rubber, plastic, and related synthetic materials	.62
28j	Miscellaneous parts of materials other than metal, wood, or textiles	.33
11t	Forming (non-powered)	.30
17j	Paper and paper materials	.30
Dimension C-15: Handling/processing earth materials.		
5j	Non-processed geological materials	.58
45a	Earth working	.43
11j	Earth materials	.40
16t	Earth working (non-powered)	.35
75t	Material conveyors	.30
Dimension C-16: Mechanical fastening.		
29t	Mechanical fastening (portable powered)	.66
33t	Perforating/boring (portable powered)	.56
6t	Mechanical fastening (non-powered)	.46
17a	Lying	.39

Table 7 (continued)

	Work Dimension	Rotated Loading[a]
Dimension C-16: Continued.		
26j	Miscellaneous wooden parts, excluding construction components	.37
41t	Degree of precision in portable powered tool/equipment usage	.31
32a	Installing/connecting	.31
30j	Transportation and mechanized equipment	.30
Dimension C-17: Liquid application/coating.		
30t	Liquid application/coating (portable powered)	.54
8t	Liquid application/coating (non-powered)	.43
15t	Cleaning (non-powered)	.37
53a	Physical treatment, excluding surgery	.37
20t	Degree of precision in hand tool usage (non-powered)	.36
56t	Liquid application/coating (stationary machines and equipment)	.34

[a]Rotated loadings less than .30 were omitted.

*This item has since been deleted from the OAI.

include: pharmacist, dye weigher, extractor operator, twitchell operator, and polymerization foreman.

Dimension C-5: Stationary material-removing machine operation. The various elements loading on this dimension seem to focus upon the operation of stationary machines that remove material through shaping, drilling, and grinding. These items describe a variety of machine-related operations and associated activities involved in the modification of metal materials. Jobs receiving high scores on this dimension include: Turret-lathe set-up operator, tool; boring-mill set-up operator; tool-and-die maker; and honing machine set-up operator, tool.

Dimension C-6: Sewing, stitching, and related activities. The items comprising this dimension define a rather specific domain of activity which centers around the type of materials acted upon (i.e., textile, leather, and related synthetic materials). The nature of this dimension is further indicated by the type of jobs which received high factor scores. These jobs include: hemmer, tailor, sewing machine operator, upholsterer, garment patternmaker, and fabric weaver.

Dimension C-7: Preparation/modification of surfaces. This dimension emphasizes a variety of work activities involved in the preparation and modification of object surfaces, including surface finishing, abrading, polishing, shaping, and scraping. Among those jobs receiving high scores on this dimension were jewelry polisher, hand sander (wood-working) and wood and plastic patternmakers.

Dimension C-8: Heat and chemical treatment. The work elements characteristic of this dimension reveal an involvement with stationary machines and equipment for the purpose of treating materials with heat, chemicals, or pressure. Examples of jobs which received high scores on this factor include: kiln burner (brick and tile), drier operator (glue), treating engineer (wood), machine silver stripper (mirror), and plater (pen and pencil).

Dimension C-9: Joining/attaching. The elements comprising this dimension all seem to pertain to some aspect of material joining. Jobs receiving high scores on this dimension include: bio-instrumentation technician, upholsterer, bricklayer, floor rolling carpenter, foreman (finish flooring), and utility man (flooring).

Dimension C-10: Cutting/processing food materials. The elements characterizing this dimension describe several means of cutting materials, particularly food materials. Among the jobs receiving high scores on this factor are meat cutter, fish cleaner, and cook.

Dimension C-11: Precision assembling. This dimension is composed of a number of work elements which suggest precision and dexterity in assembly activities. Examples of jobs receiving high scores on this dimension include: instrument solderer, electronics assembler, heavy assembler (electrical equipment), semiconductor assembler, and can solderer.

Dimension C-12: Plant and animal care. This dimension emphasizes manual activities in working with earth as well as plant and animal life. Among the jobs receiving high scores on this factor were forester aide, livestock caretaker, vegetable farm hand, and general farm hand.

Dimension C-13: Cutting/modifying wood and related materials. This dimension is rather narrowly defined in terms of both the activity involved (cutting by sawing) and the material being acted upon (wood). This is further reflected by the jobs receiving high scores on the factor. Included among these jobs were gang sawyer, carpenter helper, dovetail machine operator, and veneer clipper.

Dimension C-14: Material forming. This factor reveals a clear emphasis on activities involved in forming rubber, plastic, and synthetic materials. Examples of jobs receiving high scores on this dimension include: punch-press operator, record press foreman, injection-molding machine tender (plastics), extruder operator (plastics), and shoe filler.

Dimension C-15: Handling/processing earth materials. This dimension involves the handling and processing of non-processed and processed earth materials. Among the jobs receiving high scores on this factor were bricklayer helper, screenman (coke), kiln burner (brick), scraper operator, and foundry worker.

Dimension C-16: Mechanical fastening. The elements comprising this dimension emphasize the use of mechanical tools and devices for connecting and attaching purposes (see OAI Items 6t and 29t). A degree of precision in the use of portable powered tools is also involved in the factor. Examples of jobs with high scores on this dimension include: air-conditioning installer, carpenter helper, auto mechanic, aircraft mechanic, boat mechanic, bracket mounter, glueman, upholsterer, and engine assembler.

Dimension C-17: Liquid application/coating. This dimension is marked by a number of work elements involving the application of liquids to objects and people. Jobs receiving high factor scores on this dimension include: hair stylist, electrician helper, nurse, electric furnace helper, shipping processor, assembler, assistant product development man (paper goods), and laborer (slaughtering and meat packing).

Dimensions of Representational Work Behavior

Six dimensions, accounting for 71 percent of the total variance, emerged from the principal components analysis of the work elements comprising this section of the OAI. Of these six factors, five were interpreted. The dimensions of Representational Work Behavior are presented in Table 8.

Table 8. Dimensions of Representational Work Behavior

	Work Dimension	Rotated Loading[a]
Dimension D-1: Verbal communication.		
16r	Speaking	.88
18r	Ordinary conversational English	.86
30r	Personalness of subject matter	.82
17r	Speaking: Level of skill or difficulty	.81
28r	Communication ratio	.76
31r	Formality or structure of communicative interaction	.66
29r	Communication precision	.61
7r	Voice transmission and storage devices	.50
15r	Writing: Level of difficulty	.39
19r	Formal, grammatically correct English	.32
Dimension D-2: Technical drawing.		
2r	Drawing devices	.87
25r	Communicates by drawing	.86
36r	Calculating/computing (level of difficulty)	.44
9r	Hand computing devices	.43
39r	Synthesizing	.40
35r	Calculating/computing	.35
38r	Analyzing	.35
Dimension D-3: Machine-related bookkeeping activities.		
3r	Keyboard devices	.76
6r	Office reproducing devices	.72
10r	Mechanical computing devices	.66
7r	Voice transmission and storage devices	.40
9r	Hand computing devices	.35

Table 8 (continued)

	Work Dimension	Rotated Loading[a]
Dimension D-4:	Clerical activities.	
36r	Calculating/computing (level of difficulty)	-.38
15r	Writing: Level of difficulty	-.44
37r	Compiling	-.47
27r	Complexity of numerical information communicated	-.50
34r	Classifying/categorizing	-.59
35r	Calculating/computing	-.59
32r	Comparing/checking	-.64
14r	Writing	-.67
26r	Communicates with numbers	-.73
1r	Writing devices	-.74
33r	Copying/recording	-.91
Dimension D-5:	Technical/symbolic information processing and communication.	
23r	Communicates with special written codes	.84
20r	Technical terms	.71
39r	Synthesizing	.53
38r	Analyzing	.44
29r	Communication precision	.31
36r	Calculating/computing (level of difficulty)	.31
19r	Formal grammatically correct English	.30
Dimension D-6:	Unnamed.	
8r	Audio-visual transmission and storage devices	.72
22r	Signals by visual means	-.52

[a]Rotated loadings less than .30 were omitted.

Dimension D-1: Verbal communication. All of the work elements loading on this dimension pertain to oral and written communication, with the main emphasis on activities related to the former. Among those jobs receiving high scores on this factor are collection clerk, account authorizer, personnel representative, museum curator, and nurse.

Dimension D-2: Technical drawing. This dimension emphasizes drawing and, to a lesser extent, computing, analyzing, and synthesizing. Moreover, the type of jobs receiving high scores on this dimension suggests that these activities are of a highly technical nature. Included among these jobs are: maintainability design engineer, nuclear engineer, production engineer, detail draftsman, and tool designer.

Dimension D-3: Machine-related bookkeeping activities. This dimension emphasizes the use of representational devices to process numerical information. An involvement with numerical information and record keeping can be inferred from the type of jobs receiving high scores on this factor. Among these jobs are: accountant, payroll clerk, collection clerk, production clerk, and order clerk.

Dimension D-4: Clerical activities. The elements comprising this dimension deal with a wide range of activities related to the clerical aspect of work. Jobs receiving high scores on this dimension include: collection clerk, tallyman, accountant, production clerk, account authorizer, label processor, and forester aide.

Dimension D-5: Technical/symbolic information processing and communication. This dimension seems to overlap somewhat with Dimension D-2 (Technical drawing); however, here the emphasis is on the processing and communication of technical terms and codes, and there is no involvement with graphic representation. Furthermore, Dimension D-5 places a heavier emphasis on synthesizing and analyzing. Jobs receiving high scores on this factor include: organic chemist, pharmacist, chemical operator, spectroscopist, microbiology lab technician, bio-instrumentation technician, maintainability design engineer, petroleum production engineer, electronic engineer, and nuclear engineer.

Dimension D-6: Unnamed. Since only two items (loading in opposite directions) mark this factor, and since an examination of the factor scores for jobs did not suggest any meaningful commonality between the items, this dimension was not interpreted.

Dimensions of Interpersonal Work Behavior

As a result of the component analysis of this section of the OAI, seven dimensions were extracted and rotated. These dimensions explained 72 percent of the total variance in the intercorrelation matrix. All of these dimensions were interpreted and are presented in Table 9.

Table 9. Dimensions of Interpersonal Work Behavior

	Work Dimension	Rotated Loading[a]
Dimension E-1: Supervisory activities.		
10p	Disciplining (supervisory)	.95
9p	Organizing (supervisory)	.93
8p	Personnel actions (supervisory)	.92
27p	Interacting with subordinates	.89
5p	Close supervision of subordinates	.89
7p	Evaluating (supervisory)	.88
6p	General supervision of subordinates	.58
15p	Teaching/instructing	.53
21p	Pacifying/placating	.45
Dimension E-2: Sales/customer service activities.		
30p	Interacting with customers	.93
14p	Persuading	.73
13p	Demonstrating	.62
2p	Serving/catering	.56
11p	Giving information to others	.45
12p	Obtaining information from others	.37
28p	Interacting with clients or patients	.36
Dimension E-3: Subordinate activities.		
25p	Interacting with superiors	.80
3p	Directions received (degree of specificity)	.77
Dimension E-4: Consultation activities.		
16p	Advising/counseling	.78
20p	Debating/discussing	.75
29p	Interacting with consultants or advisors	.73
12p	Obtaining information from others	.33

Table 9 (continued)

	Work Dimension	Rotated Loading[a]
Dimension E-5:	Teaching/instructing.	
32p	Interacting with students	.90
15p	Teaching/instructing	.60
13p	Demonstrating	.42
Dimension E-6:	Diverting/serving activities.	
23p	Diverting/entertaining	.74
31p	Interacting with the general public	.60
2p	Serving/catering	.44
28p	Interacting with clients or patients	.43
Dimension E-7:	Assisting superiors.	
12p	Obtaining information from others	-.30
25p	Interacting with superiors	-.31
6p	General supervision of subordinates	-.33
11p	Giving information to others	-.36
1p	Assisting superiors	-.77

[a]Rotated loadings less than .30 were omitted.

Dimension E-1: Supervisory activities. This dimension loads heavily on supervisory activities such as organizing, evaluating, disciplining, and close general supervision of subordinates. Thus, as would be expected, those jobs receiving the highest scores on this factor included various types of managers, supervisors, and foremen.

Dimension E-2: Sales/customer service activities. The elements characterizing this dimension rather clearly indicate an involvement with sales and customer service. This interpretation is consistent with the type of jobs receiving high factor scores. These jobs include a number of retail sales and store manager positions.

Dimension E-3: Subordinate activities. This dimension concerns interpersonal activities typically associated with subordinate status. Although only two work elements mark the factor, the nature and magnitude of their loadings seemed to justify this interpretation. Examples of jobs receiving high scores on this dimension include: first helper on an electric furnace, nurse, nurse's aide, and several low-level plant production jobs.

Dimension E-4: Consultation activities. This dimension seems to deal with activities in which the incumbent consults with, and possibly attempts to influence, others. This is reflected by the significant loadings of advising/counseling and debating/discussing. That the incumbent often interacts with consultants and advisors suggests that he may also be influenced by others. Jobs receiving high factor scores on this dimension include: personnel representative, technical reporting analyst, administrative assistant, coordinator of personnel services, university faculty member, and superintendent of schools.

Dimension E-5: Teaching/instructing. A concern with activities related to teaching or instructing is clearly indicated by the items in this factor and is further reflected in the type of jobs receiving high factor scores. Examples of these jobs are: bridge instructor, college professor, personal service representative, and chief pilot.

Dimension E-6: Diverting/serving activities. Although this dimension is not easily labeled, it involves both diverting/entertaining and providing personal service to others. Furthermore, the jobs that received high factor scores appear to fall into one or the other of these categories. These jobs include: bugler, housemother, catering manager, nurse, nurse's aide, housekeeper, museum curator, passenger car conductor, physical therapist, and silver saleslady.

Dimension E-7: Assisting superiors. Although this dimension is not very well defined, it primarily involves providing assistance to superiors: the item with the highest loading is "Assisting" (superiors), and the remaining items in the factor seem to support this interpretation. The major emphasis, however, is clearly on providing assistance to superiors. Examples of jobs receiving high scores on this dimension include: forester aide, first helper on an electric furnace, fitting room checker, payroll clerk, and order clerk.

Dimensions of Work Goals

The component analysis of the OAI work elements within this section yielded a total of 15 dimensions which explained 65 percent of the total variance. Of these 15 dimensions, 14 were interpretable. The dimensions of work goals are presented in Table 10 and discussed in the following paragraphs.

Dimension F-1: Bookkeeping objectives. This dimension is defined by a variety of work elements dealing with numerical and symbolic objectives, particularly those related to business data. Examples of jobs receiving high loadings on this dimension include: accountant, collection clerk, production clerk, administrative assistant, stock clerk, account authorizer, and warehouse manager.

Dimension F-2: Electrical/electronic objectives. The work elements having substantial loadings on this dimension comprise the OAI section entitled Electrical Objectives in its entirety. The major emphasis is on objectives pertaining to the maintenance or restoration of proper electrical/electronic functioning. Also important, but to a lesser degree, are objectives pertaining to the assembly, installation, and regulation or control of electrical/electronic devices. Of still less, yet significant, concern are objectives related to electrical/electronic schematics or diagrams, written communication of electrical/electronic information, and electrical/electronic innovation or plans. Those jobs receiving high scores on this factor include several electrician jobs, bio-instrumentation technician, playback operator, and instrument and appliance solderer.

Dimension F-3: Semantic/symbolic technical objectives. This dimension emphasizes work goals involving the production of technical information in written, symbolic, and graphic form. The inclusion in this factor of four items concerning innovations and plans and four items dealing with written communications suggests a class of work goals requiring creativity and abstract thinking. This interpretation is supported by the type of jobs receiving high factor scores--e.g., production engineer, maintainability design engineer, nuclear engineer, tool designer, and detail draftsman.

Dimension F-4: Mechanical objectives. All of the items loading on this dimension are concerned with the accomplishment of mechanical objectives requiring direct contact with, or close proximity to, mechanical devices. The concern is with objectives related to the maintenance and restoration of proper mechanical functioning and, to a lesser extent, with the installation, regulation, and control of mechanical devices. Examples of jobs receiving high scores on this dimension include: operating engineer, maintenance mechanic, pipe layer, boat mechanic, propellant-and-gas mechanic, stationary engineer, power-line repairman, air-conditioning installer, and sewing machine repairman.

Table 10. Dimensions of Work Goals

	Work Dimension	Rotated Loading[a]
Dimension F-1:	Bookkeeping objectives.	
81g	Recorded or transcribed numerical data	.82
94g	Balanced, verified, or updated business/organizational records	.79
79g	Solutions to standard arithmetic problems	.71
88g	Semantic/symbolic material verified	.66
96g	Business/organizational data gathered, compiled, or displayed	.65
82g	Numerical data displayed	.64
72g	Routine written output	.52
76g	Written material categorized	.50
87g	Reproduced semantic/symbolic material	.36
83g	Numerical information orally communicated	.30
90g	Merchandise shelved, packaged, stored, demonstrated, or otherwise handled	.30
Dimension F-2:	Electrical/electronic objectives.	
14g	Electrical/electronic functioning maintained	.90
15g	Electrical/electronic functioning restored	.90
13g	Causes of electrical/electronic malfunction located or identified	.88
12g	Substandard conditions of electrical/electronic devices detected	.84
18g	Satisfactory output from electrical/electronic devices detected	.83
17g	Electrical/electronic devices regulated, adjusted, or controlled	.80
16g	Electrical/electronic devices installed or assembled	.75
19g	Electrical/electronic schematics and/or diagrams	.53

Table 10 (continued)

	Work Dimension	Rotated Loading[a]
Dimension F-2: Continued.		
21g	Written communication of electrical/electronic information	.44
20g	Electrical/electronic innovations or plans	.35
Dimension F-3: Semantic/symbolic technical objectives.		
11g	Written communication of mechanical information	.91
10g	Mechanical plans or innovations	.90
39g	Drawings or diagrams of constructed, assembled, modified, fabricated, or arranged objects/ materials	.89
9g	Mechanical drawings	.82
37g	Written communications pertaining to construction, installation, or spatial arrangement	.69
84g	Completed diagrams, charts, and maps	.67
38g	Written communication pertaining to material/ object modification, assembly, or fabrication	.62
80g	Solutions to advanced mathematical problems	.53
19g	Electrical/electronic schematics and/or diagrams	.50
36g	Innovations or plans in assembly, fabrication, or material modification	.48
35g	Innovations or plans in construction, installation, or spatial arrangement of objects	.47
21g	Written communication of electrical/electronic information	.45
20g	Electrical/electronic innovations or plans	.36
Dimension F-4: Mechanical objectives.		
4g	Proper mechanical functioning restored	.86
2g	Causes of mechanical malfunction located or identified	.84

Table 10 (continued)

	Work Dimension	Rotated Loading[a]
Dimension F-4: Continued.		
3g	Mechanical functioning maintained	.77
1g	Substandard conditions of mechanical devices detected	.75
5g	Mechanical devices installed or assembled	.64
7g	Properly regulated or controlled mechanical devices	.57
6g	Satisfactory output from mechanical devices	.53
24g	Installed or attached objects	.37
8g	People, objects, or materials transported	.30
Dimension F-5: Spatial arrangement objectives.		
57g	Aesthetically arranged objects or things	.83
33g	Spatially arranged objects	.82
35g	Innovations or plans in construction, installation, or spatial arrangement of objects	.56
91g	Advertising materials produced, displayed, or disseminated	.45
34g	Properly located or placed objects	.41
Dimension F-6: Health objectives.		
66g	Medically related service tasks completed	.88
63g	Causes or potential causes of health problems identified	.75
105g	Improved adjustment or adaptation of others	.75
100g	Improved state of grooming or appearance of people	.60
70g	Written biological/health communication completed	.40

Table 10 (continued)

	Work Dimension	Rotated Loading[a]
Dimension F-7: Organizational objectives.		
84g	Completed diagrams, charts, and maps	-.30
92g	Employee relations accomplishments	-.30
73g	Non-standard or innovative written output	-.35
99g	Written business/organizational communication	-.37
95g	Satisfactory index of organizational performance attained	-.41
96g	Business/organizational data gathered, compiled, or displayed	-.48
75g	Written material edited or checked for composition	-.49
74g	Written material reviewed or edited for content	-.53
108g	Innovations or plans pertaining to people	-.71
97g	Organizational plans or innovations	-.76
Dimension F-8: Objectives pertaining to water conditions.		
50g	Maintenance of satisfactory water conditions and/or detection of unsatisfactory water conditions	.92
54g	Written communications pertaining to water, atmospheric, or astronomical conditions or events	.91
77g	Oral information communicated	.66
Dimension F-9: Material/substance treatment objectives.		
29g	Treated materials or substances	.68
28g	Materials/substances modified by miscellaneous mechanical actions, excluding material removal and forming	.54
7g	Properly regulated or controlled mechanical devices	.43
6g	Satisfactory output from mechanical devices	.42

Table 10 (continued)

	Work Dimension	Rotated Loading[a]
Dimension F-10:	Object joining/construction objectives.	
22g	Completed structures and other constructed objects	.68
31g	Satisfactory condition of assembled or fabricated objects, excluding mechanical and electrical/electronic devices	.56
24g	Installed or attached objects	.52
27g	Finished or prepared surfaces	.40
Dimension F-11:	Business/sales objectives.	
99g	Written business/organizational communication	-.30
90g	Merchandise shelved, packaged, stored, demonstrated, or otherwise handled	-.32
83g	Numerical information orally communicated	-.48
91g	Advertising material produced, displayed, or disseminated	-.55
103g	Attitude, opinion, or belief change in others	-.65
107g	Enjoyment, satisfaction, or mood change of others	-.65
93g	Public relations accomplishments	-.70
89g	Completed sales or business/organizational transactions	-.72
Dimension F-12:	Unnamed.	
20g	Electrical/electronic innovations or plans	.53
21g	Written communication of electrical/electronic information	.47
34g	Properly located or placed objects	.44
8g	People, objects, or materials transported	.35
23g	Assembled or fabricated objects	-.40

Table 10 (continued)

	Work Dimension	Rotated Loading[a]
Dimension F-13: Clerical objectives.		
85g	Information encoded into written symbols or codes	.68
78g	Verbal material transcribed	.54
75g	Written material edited or checked for composition and format	.52
76g	Written material categorized	.44
73g	Non-standard or innovative written output	.43
74g	Written material reviewed or edited for content	.43
72g	Routine written output	.34
77g	Oral information communicated	.31
Dimension F-14: Material modification objectives.		
25g	Shaped objects	.72
26g	Formed objects	.53
27g	Finished or prepared surfaces	.37
Dimension F-15: Objectives related to the behavior of others.		
104g	Others' compliance with directions, rules, or laws insured or monitored	.76
92g	Employee relations accomplishments	.67
102g	Others' knowledge improved or assessed	.65
77g	Oral information communicated	.56
101g	Physical competence of others improved or assessed	.55
95g	Satisfactory index of organizational performance attained	.46
72g	Routine written output	.30
107g	Enjoyment, satisfaction, or mood change of others	.30

[a]Rotated loadings less than .30 were omitted.

Dimension F-5: Spatial arrangement objectives. This dimension emphasizes objectives pertaining to the spatial arrangement of objects and materials. In addition, the items marking this factor suggest an aesthetic concern in these objectives. Those jobs which received high factor scores include: illustrator, silver saleslady, store manager, salesperson (men's furnishings), display man, cloth designer, and executive housekeeper.

Dimension F-6: Health objectives. The work elements loading substantially on this dimension deal with problems of health, adjustment, and the physical condition of people. The jobs with the highest factor scores were general duty nurse, nurse's aide, and physical therapist.

Dimension F-7: Organizational objectives. This dimension emphasizes a number of business/organizational objectives typically associated with administrative, managerial, and staff positions. These objectives include planning, innovation, written business/organizational communication, business/organizational data gathering, satisfactory organizational performance, and employee relations accomplishments. Some of the jobs receiving high scores on this dimension were: market-research analyst, administrative assistant, coordinator of personnel services, nuclear engineer, technical reporting analyst, and hydrologist.

Dimension F-8: Objectives pertaining to water conditions. This dimension is characterized by work elements concerned with objectives involving (1) the maintenance of satisfactory water conditions and/or detection of unsatisfactory water conditions; and (2) written or oral communications pertaining to water, atmospheric, or astronomical conditions or events. It should be noted that the three work elements with substantial loadings are probably the only items in the Work-Goal section of the OAI that could meaningfully characterize this dimension (since Item 53g was not included in the factor analysis). Examples of jobs that received high scores on this factor include: microbiologist, laboratory tester, hydrologist, stationary engineer, forester aide, bio-instrumentation technician, and ice maker.

Dimension F-9: Material/substance treatment objectives. This dimension emphasizes work goals related to the treatment of materials or substances. Such treatment might involve chemicals, heat, and mechanical agitation (e.g., mixing, centrifuging, and washing). Jobs receiving high scores on this factor include: polymerization foreman; organic chemist; extractor operator, solvent process; finish photographer; feed mill chief; and cloth finisher.

Dimension F-10: Object joining/construction objectives. This dimension is primarily concerned with objectives related to object joining and construction. The substantial loading of Item 31g (Satisfactory condition of assembled or fabricated objects) might reflect a concern with installation objectives (see Item 24g). Since Item 30g (Satisfactory conditions of structures or constructed objects)

was not included in the factor analysis, the likelihood of its loading substantially on this dimension is speculative; however, this item is consistent with the interpretation of Dimension F-10. Among the jobs with high scores on this factor were: bio-instrumentation technician; foreman, production department (aerospace); shipyard superintendent; spar mechanic; and plaster patternmaker (aircraft manufacturing).

Dimension F-11: Business/sales objectives. The work elements loading substantially on this dimension define a variety of objectives related to the sales aspect of business. These elements deal with goals such as selling, public relations, advertising, and demonstrating or handling merchandise. Included also are items concerning the effect of such activities on people (i.e., enjoyment; satisfaction; and change in mood, attitude, opinion, or belief). The jobs receiving high scores on this dimension were predominantly in the sales field, thus reinforcing the interpretation.

Dimension F-12: Unnamed. No meaningful interpretation could be made of this dimension because of the diverse nature of the items and the apparent lack of relationship among jobs with high factor scores. Among these jobs were: bio-instrumentation technician, market-research analyst, locomotive crane operator, factory maintenance man, and maintainability design engineer.

Dimension F-13: Clerical objectives. This dimension emphasizes objectives typically associated with clerical jobs. These objectives involve such elements as encoding, transcribing, editing/checking, and categorizing. Although Item 73g deals with a higher level of work goals than typically associated with clerical jobs, clerical objectives predominate in the factor. Furthermore, this interpretation is supported by the types of jobs that received high factor scores, including: correspondence clerk, sports editor, telegrapher, transcribing-machine operator, collection clerk, account authorizer, and production clerk.

Dimension F-14: Material modification objectives. The work elements characterizing this dimension concern objectives pertaining to the modification of objects/materials by material removal (e.g., chipping, shearing, grinding, drilling, etc.), material forming, and surface finishing. The inclusion of shaping and forming and the exclusion of chemical, electrical, and other types of treatment distinguish Dimension F-14 from Dimension F-9 (Material/substance treatment objectives). Thus, the two dimensions tend to complement each other and, together, account for all of the OAI material-modification objectives. Jobs receiving high scores on this dimension include: Turret-lathe set-up operator, tool; Ludlow-machine operator; tool and die maker; general foundry worker; and aircraft model maker.

Dimension F-15: Objectives related to the behavior of others. This dimension emphasizes a variety of work objectives pertaining to the modification, control, and evaluation of the behavior of others. Examples of jobs that received high scores on this factor include:

several foremen jobs, factory supervisor, personnel representative, shipyard superintendent, personal service representative, market-research analyst, finish inspector-instructor (pottery and porcelain), executive housekeeper, feed mill chief, store manager, warehouse manager, and bridge instructor.

Dimensions of Work Context

The component analysis of the work elements comprising the Work Context section of the OAI yielded 12 dimensions which accounted for 63 percent of the total variance. Eleven of these dimensions could be meaningfully interpreted. All twelve dimensions are presented in Table 11 and discussed separately below.

Dimension G-1: Responsibility. The first dimension emerging from this analysis emphasizes working conditions in which the incumbent has a considerable amount of responsibility. The positive loading on Item 25c (Business attire) and negative loading on Item 22c (Work clothes) indicate a white collar type of position. Among those jobs receiving high scores on this dimension were museum curator, production engineer, manager of an industrial organization, and shipyard superintendent.

Dimension G-2: Unpleasant outdoor working conditions. The work elements characterizing this dimension concern various unpleasant work situations occurring in the outdoor environment. These conditions (i.e., moving or falling objects, unpleasant weather, vibration, and dirty environment) seem to be most prevalent in heavy construction work and, in fact, those jobs which received the highest scores on this factor were jackhammer operator, power-shovel operator, shipyard superintendent, and scraper operator. Other jobs receiving high factor scores include: log-stacker operator, fisherman, dock attendant, and a number of farm hand jobs.

Dimension G-3: Steady vs. irregualr work. This dimension is clearly bipolar in structure. Item 32c (Steady work) has a high positive loading, contrasted with the substantial negative loadings on Items 33c (Seasonal work) and 34c (Irregular work).

Dimension G-4: Job structure. This dimension emphasizes highly structured working conditions in which the goals, procedures, standards, timing, etc., are restricted or prescribed by the nature of the job. The substantial loadings on Items 8c (Noise intensity), 36c (Changing shift work), and 4c (Dirty environment) are consistent with this interpretation, since these conditions are typically associated with structured factory jobs. Some of the jobs that received high scores on this dimension were: screenman (coke), drier operator (glue), garnetter, first helper on an electric furnace, log sawyer, and jewelry polisher.

Table 11. Dimensions of Work Context

	Work Dimension	Rotated Loading[a]
Dimension G-1:	Responsibility.	
46c	Updating knowledges, techniques, and skills	.77
47c	Financial or material consequences of errors	.73
49c	Intangible consequences of errors	.73
31c	Task diversity	.71
50c	Organizational responsibility	.60
41c	Distractions or interruptions	.50
25c	Business attire	.42
45c	Time away from home	.42
59c	Civic obligations	.41
48c	Safety consequences of errors	.33
22c	Work clothes	-.31
Dimension G-2:	Unpleasant outdoor working conditions.	
14c	Moving or falling objects	.77
1c	Time spent inside/outside	.75
9c	Unpleasant weather conditions	.75
6c	Vibration	.64
4c	Dirty environment	.32
Dimension G-3:	Steady vs. irregular work.	
32c	Steady work	.89
37c	Variable hours	-.58
34c	Irregular work	-.76
33c	Seasonal work	-.79
Dimension G-4:	Job structure.	
29c	Performance standards	.78
26c	Work procedure	.77

Table 11 (continued)

	Work Dimension	Rotated Loading[a]
Dimension G-4: Continued.		
27c	Timing and sequence	.77
30c	Goals	.76
43c	Confinement to a specific work space	.66
8c	Noise intensity	.46
52c	Working individually in the presence of co-workers or others where social interaction is possible	.43
36c	Changing shift work	.42
4c	Dirty environment	.33
Dimension G-5: High temperature conditions.		
10c	High temperature	.79
16c	Exposure to burns	.71
12c	Sudden temperature changes	.56
36c	Changing shift work	.37
51c	Working alone with little or no opportunity for social interaction	-.30
Dimension G-6: Unpleasant or trying interpersonal situations.		
22c	Work clothes	.39
25c	Business attire	-.32
41c	Distractions or interruptions	-.33
54c	Working individually in a one-to-one relationship with a customer, client, student, etc., where social interaction is restricted primarily to that person	-.66
57c	Interpersonal conflict	-.73
58c	Unpleasant social relationships	-.79

Table 11 (continued)

	Work Dimension	Rotated Loading[a]
Dimension G-7: Wet or damp working conditions.		
2c	Wet	.81
3c	Humid	.80
11c	Low temperature	.31
21c	Safety apparel	.30
Dimension G-8: Apparel: Uniform vs. business attire.		
24c	Uniform	.66
48c	Safety consequences of errors	.32
25c	Business attire	-.30
59c	Civic obligations	-.44
Dimension G-9: Unnamed.		
51c	Working alone with little or no opportunity for social interaction	.60
53c	Working jointly with others as part of a team where social interaction and co-operation are necessary	.48
45c	Time away from home	.34
24c	Uniform	.32
52c	Working individually in the presence of co-workers or others where social interaction is possible	-.72
Dimension G-10: Mechanical hazards.		
25c	Business attire	.34
31c	Task diversity	-.31
20c	Overall hazard of the job	-.40
22c	Work clothes	-.41
48c	Safety consequences of errors	-.46

Table 11 (continued)

	Work Dimension	Rotated Loading[a]
Dimension G-10: Continued.		
8c	Noise intensity	-.56
13c	Mechanical hazards	-.74
Dimension G-11: Toxic conditions.		
18c	Toxic conditions	.74
21c	Safety apparel	.54
19c	Other hazards	.50
20c	Overall hazard of the job	.44
48c	Safety consequences of errors	.31
Dimension G-12: Electrical hazards.		
17c	Electrical hazards	.74
15c	High places	.65
12c	Sudden temperature changes	.32
20c	Overall hazard of the job	.30

[a]Rotated loadings less than .30 were omitted.

Dimension G-5: High temperature conditions. The elements marking this dimension deal with conditions in which the incumbent is exposed to very high temperatures, danger of burns, and sudden temperature changes. The one negative loading (Item 51c) is not inconsistent with this interpretation. An examination of the factor scores for jobs adds further clarification to this dimension. Among the jobs with high factor scores were: first helper on an electric furnace, kiln burner, glove former, kettle cook, and furnace operator.

Dimension G-6: Unpleasant or trying interpersonal situations. The items defining this dimension pertain to interaction between the incumbent and other individuals under unpleasant or trying circumstances. Included among these items are unpleasant social relationships, interpersonal conflict, and distractions and interruptions. The wearing of business attire by the incumbent is also indicated. Examples of jobs receiving high scores on this factor include: managers, salesmen, nurse, nurse's aide, account authorizer, collection clerk, and guard (retail trade).

Dimension G-7: Wet or damp working conditions. This dimension emphasizes working conditions in which the incumbent is exposed to an excessive amount of moisture or humidity. Cold temperatures frequently add to the unpleasantness of the situation. Those jobs which received high factor scores on this dimension include: laborer (slaughtering and meat packing), wet wash assembler (laundry), ice maker, fish cleaner, dye weigher, centrifuge operator, and dairy processing equipment operator.

Dimension G-8: Apparel: Uniform vs. business attire. This dimension has a bipolar structure. The items with positive loadings deal with work situations in which the incumbent wears a uniform and has some responsibility for the physical welfare of himself and others, whereas the items with negative loadings refer to situations in which the incumbent wears business attire and has responsibilities of a civic nature. Examples of jobs receiving high scores on the uniform end of this dimension include: house officer, watchman, train conductor, nurse, nurse's aide, and physical therapist. Among those jobs receiving high scores on the business-attire end of this dimension were: hydrologist, superintendent of schools, museum curator, personnel services coordinator, personal service representative (telephone and telegraph), and personnel representative.

Dimension G-9: Unnamed. The composition and structure of this dimension made meaningful interpretation quite difficult. The work elements are primarily concerned with the amount of social interaction involved in the work situation. Although the loadings clearly indicate a bipolar relationship among these elements, the basis of this relationship was difficult to discern.

Dimension G-10: Mechanical hazards. This dimension is characterized by work elements pertaining to situations in which the incumbent is directly exposed to mechanical hazards. Items 8c (Noise

intensity) and 22c (Work clothes) are typically associated with such situations. Some of the jobs that received high scores on this factor include: veneer clipper, machine set-up operator, leadman, meat cutter, sheet metal worker, Turret-lathe set-up operator, tubemill operator, scraper operator, and thimble press operator.

Dimension G-11: Toxic conditions. This dimension emphasizes work situations in which the incumbent's health is endangered by exposure to toxic conditions and miscellaneous hazards such as explosives and radiant energy (see Item 19c). Included among the jobs that received high factor scores were: dynamite-cartridge crimper, dope-dry-house operator, logstacker operator (sawmill), induction-machine operator, gang sawyer (sawmill), panelboard operator (mining and quarrying), and several foundry jobs.

Dimension G-12: Electrical hazards. This dimension emphasizes exposure to electrical hazards. Examples of jobs receiving high factor scores on this dimension include: first helper on an electrical furnace, light cleaner, patrolman (light, heat, and power), and various electrician jobs. An examination of these jobs helps explain the significant loadings on Items 15c (High places) and 12c (Sudden temperature changes): these conditions often occur in job situations involving electrical hazards.

DISCUSSION AND SUMMARY

The present study was part of a larger project undertaken for the purpose of applying systematic job-analysis procedures--particularly those developed by E. J. McCormick at Purdue University--to the problem of defining and measuring job commonalities relevant to occupational education. This specific study was designed to derive a tentative but comprehensive set of work dimensions for the description and classification of jobs and occupations. For this purpose, a 622-item job-rating inventory, the Occupation Analysis Inventory (OAI), was employed in the analysis of 400 jobs.

The first phase of this study involved the computation of inter-rater reliabilities for the OAI work elements, or items. The reliability coefficients obtained for these items, though based on relatively small sample sizes in a number of cases, were for the most part statistically significant and of generally acceptable magnitude in comparison to coefficients reported in similar studies (i.e., studies in which written job descriptions were rated). Furthermore, for reasons indicated earlier (see p. 22), these reliabilities should be considered lower-bound estimates of the "true" reliabilities.

Following the reliability analyses, seven separate principal component factor analyses were performed on groups of items contained in the various sections of the OAI. A total of 81 dimensions were extracted in these analyses, 77 of which were interpreted. These dimensions are summarized in Table 12 and, in general, seem quite meaningful. In a number of cases, the titles of these dimensions correspond to a priori categories in the OAI. For example, 14 of the 17 factors emerging from the Information Received section and 6 of the 7 factors obtained from the Mental Activities section can be assigned to OAI categories.

It is appropriate to reiterate here a point made initially by Gordon and McCormick (1963), and repeated later by Jeanneret and McCormick (1969), concerning the nature of the dimensions emerging from this kind of study. These investigators noted that in factor analytic studies of human abilities, it is usually assumed that the basis for the intercorrelations among various tests lies in the existence of common underlying traits. On the other hand, factor analyses of work activities and characteristics, based on job ratings, yield dimensions which depend upon the co-occurrence of these elements in jobs and which, therefore, need not have psychological meaning similar to that of ability dimensions. Indeed, the work elements (defined activities and conditions) comprising such a factor may be quite heterogeneous in terms of their aptitude requirements, as aptitudes are currently defined and measured. For this reason, such work dimensions sometimes appear to lack internal consistency. Nevertheless, factors derived from ratings of a representative sample of jobs on a comprehensive set of work elements should reasonably well reflect the work structure as it actually exists--rather than as it might exist if we required that sets of coexisting work activities be homogeneous in terms of their aptitude requirements.

Table 12. Summary of the 81 Work Dimensions Obtained from the Seven Sectional Factor Analyses

Dimension Number	Title of Dimension
	Information Received
A-1	Technical written information
A-2	Clerical information
A-3	Electrical/electronic information
A-4	Environmental information
A-5	Information concerning mechanical devices/processes
A-6	Information concerning the physical aspects of people
A-7	Information concerning the chemical properties of materials
A-8	Art/decorative information
A-9	Direct sales information
A-10	Unnamed
A-11	Spatial/structural information
A-12	Information about groups of people
A-13	Information concerning nutrition
A-14	Indirect business/sales information
A-15	Information pertaining to physical arrangement and layout
A-16	Numerical/Graphic information
A-17	Information concerning the quality of materials
	Mental Activities
B-1	Semantic planning and problem solving
B-2	Figural perception and problem solving

Table 12 (Continued)

Dimension Number	Title of Dimension
	Mental Activities (Continued)
B-3	Figural Creativity
B-4	Symbolic thinking and problem solving
B-5	Routine semantic and symbolic activities
B-6	Spatial orientation
B-7	Semantic facility and originality
	Physical Work Behavior
C-1	Maintenance and repair activities
C-2	Mechanized equipment operation
C-3	General physical vs. sedentary activities
C-4	Combining/separating processed materials
C-5	Stationary material-removing machine operation
C-6	Sewing, stitching, and related activities
C-7	Preparation/modification of surfaces
C-8	Heat and chemical treatment
C-9	Joining/attaching
C-10	Cutting/processing food materials
C-11	Precision assembling
C-12	Plant and animal care
C-13	Cutting/modifying wood and related materials
C-14	Material forming
C-15	Handling/processing earth materials

Table 12 (Continued)

Dimension Number	Title of Dimension
	Physical Work Behavior (Continued)
C-16	Mechanical fastening
C-17	Liquid application/coating
	Representational Work Behavior
D-1	Verbal communication
D-2	Technical drawing
D-3	Machine-related bookkeeping activities
D-4	Clerical activities
D-5	Technical/symbolic information processing and communication
D-6	Unnamed
	Interpersonal Work Behavior
E-1	Supervisory activities
E-2	Sales/customer service activities
E-3	Subordinate activities
E-4	Consultation activities
E-5	Teaching/instructing
E-6	Diverting/serving activities
E-7	Assisting superiors
	Work Goals
F-1	Bookkeeping objectives
F-2	Electrical/electronic objectives
F-3	Semantic/symbolic technical objectives

Table 12 (Continued)

Dimension Number	Title of Dimension
	Work Goals (Continued)
F-4	Mechanical objectives
F-5	Spatial arrangement objectives
F-6	Health objectives
F-7	Organizational objectives
F-8	Objectives pertaining to water conditions
F-9	Material/substance treatment objectives
F-10	Object joining/construction objectives
F-11	Business/sales objectives
F-12	Unnamed
F-13	Clerical objectives
F-14	Material modification objectives
F-15	Objectives related to the behavior of others
	Work Context
G-1	Responsibility
G-2	Unpleasant outdoor working conditions
G-3	Steady vs. irregular work
G-4	Job structure
G-5	High temperature conditions
G-6	Unpleasant or trying interpersonal situations
G-7	Wet or damp working conditions
G-8	Apparel: Uniform vs. business attire

Table 12 (Continued)

Dimension Number	Title of Dimension
	Work Context (Continued)
G-9	Unnamed
G-10	Mechanical hazards
G-11	Toxic conditions
G-12	Electrical hazards

The factors obtained in this study must be considered tentative until they can be verified through replication (Armstrong and Soelberg, 1968). Accordingly, a subsequent study in the ergometric series will repeat the factor analyses conducted in the present study, using a new sample of jobs. The second set of factors will then be compared with the present factors by use of Tucker's (1951) coefficient of congruence. If the results of these comparisons indicate a relatively stable factor structure, the two samples of jobs will be combined ($n \simeq 800$) in order to obtain maximum variation on the OAI items, and the factor analyses will be performed again. Finally, the last set of factors will, themselves, be subjected to a factor analysis in order to (1) reduce the redundancy in the original set of factor, (2) reduce the factors to a more manageable number, and (3) produce factors which (hopefully) can be interpreted in accordance with the information-processing paradigm shown in Figure 1 (p. 17)--i.e., factors defined in terms of Information Received, Mental Activities, Work Behavior, Work Goals, and Work Context. Exploratory analyses performed on data gathered subsequent to this study suggest that there will be approximately 20-25 of these "high-order" factors.

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APPENDICES

Appendix A

Procedures for Drawing the Job Sample

The job sample was drawn in proportion to numbers of jobs under major DOT categories. Under the DOT classification scheme, all jobs are grouped into nine major occupational categories identified by the numbers 0-9 in the first digit of the code. These, in turn, are divided into 84 two-digit occupational divisions which are further subdivided into 603 three-digit groups.

Volume II of the DOT lists four different types of job titles under each of the three-digit occupational groups. Base titles are defined and accompanied by code numbers in Volume I; these titles appear at the left-hand margin in all capital letters. Defined related titles are defined in Volume I indented under the definitions of the base titles and carry the same code number as the latter; they also appear in all capital letters and are indented under base titles in Volume II. Alternate titles appear in all lower case letters under base titles; these are alternate or synonym titles for those which immediately precede them. Undefined related titles appear with initial capital letters under base titles; these are specializations of the more general titles described in the definitions in which they appear and they receive the same code as the base titles.

Determining Number of Jobs to be Drawn from Two-Digit Divisions

The steps which were followed in determining the number of jobs to be drawn from each two-digit occupational division are listed below:

(1) First, a count was taken under each three-digit group of the number of base and defined related titles. This number was then recorded next to the title of the three-digit group.

(2) Next, the total number of base and defined related titles within three-digit groups were summed for each of the 84 two-digit divisions.

(3) The totals for two-digit divisions were then summed across all 84 divisions, yielding a grand total of 13,845 base and defined related titles.

(4) Using the grand total of 13,845 as a denominator, each of the two-digit totals was divided by this denominator. For example, the first two-digit division (00-01) contained 304 titles; thus 304 was divided by 13,845 yielding a proportion of .0220.

(5) Since it was decided that the job sample would contain 400 jobs, the sample of 400 was subsequently multiplied by the proportion that had been derived for each two-digit division. Thus, the proportion of .0220 for the first two-digit division was multiplied by 400 yielding a figure of 8.800. This figure represents the number of jobs in the sample of 400 which should be drawn from the first two-digit division (00-01). The resulting figures were rounded to whole numbers (e.g., 8.800 was rounded to 9); the total of these whole numbers

across all 84 divisions equalled 401. Under this procedure only two of the 84 divisions had a rounded whole number of 0.

Determining Number of Cases to be Drawn from Three-Digit Codes

There are 13,845 base and defined related titles in the DOT, and the sample was to contain 400 occupations drawn in proportion to the number of base and defined related titles under two- and three-digit codes. Thus, the sampling ratio was 1:34.61 or 1:35 (i.e., one case was to be sampled for every 35 base or defined related titles in the DOT).

It was decided that one case would be drawn from all three-digit codes which contain at least 18 titles (50% of 35) but less than 53 titles (150% of 35); two cases would be drawn from those three-digit codes which contain at least 53 titles (150% of 35) but less than 88 titles (250% of 35); etc. The complete sampling scheme is shown below.

Number of Titles in Three-Digit Codes	Number of Cases Drawn
18 - 52	1
53 - 87	2
88 - 122	3
123 - 157	4
158 - 192	5
193 - 227	6
228 - 262	7

A sizable number of the three-digit codes contain less than 18 base or defined related titles and therefore were not treated by the sampling procedure described above. Thus, it was necessary to combine three-digit codes containing less than 18 titles into groups which contained more than 18 titles and could therefore be represented in the sampling scheme. The procedure for combining such three-digit codes was as follows: within each two-digit occupational division, three-digit codes containing less than 18 titles were combined consecutively until the combined number of titles exceeded 18. At this point, the group was considered complete (since it warranted representation by at least one case in the sample), and a new group was started by successively combining the remaining three-digit codes containing less than 18 titles. This procedure continued until all three-digit codes containing less than 18 titles had been combined (into groups containing more than 18 titles) within a two-digit occupational division. In cases where all three-digit codes containing less than 18 titles were exhausted with the exception of remaining three-digit codes whose combined titles totaled less than 18, the latter were assigned to the previously formed groups of three-digit codes according to the following procedure: the remaining three-digit codes were added to the previously formed group with the lowest number of titles, until the total number of titles in that group exceeded 35. If the remaining three-digit codes were still not exhausted, they were assigned to the group

with the next lowest number of titles, until the number of titles in that group exceeded 35. This procedure continued until all remaining three-digit codes with less than 18 titles were exhausted. In cases where all groups of three-digit codes contained more than 35 titles, the three-digit codes with less than 18 titles were assigned on a one-per-group basis, beginning with the group containing the fewest number of titles over 18.

Correcting Total Sample Size Across Three-Digit Groups

The number of cases to be drawn from each three-digit group was determined according to the previously described sampling scheme. Sampling values (i.e., the number of cases to be drawn from each three-digit code or group of three-digit codes as determined by the sampling scheme) were then totaled within each two-digit occupational division. In cases where these totals did not equal the sample sizes that had been previously determined for two-digit occupational divisions (i.e., sample sizes determined by multiplying the proportion of titles in a given two-digit occupational division by 400), it was necessary to correct the total across three-digit codes. The correction procedure is described below.

Removing cases from the three-digit total. If the total across three-digit codes was greater than the previously determined two-digit sample size, the excess cases were removed from the three-digit total by the following procedure:

A. To remove one case:

(1) Find the three-digit group with the highest sample number and reduce its value by "1."

(2) If two or more groups have the highest sample number, then randomly select one of these groups and reduce its value by "1."

(3) If all groups have a sample number of "1," then eliminate the sample number of the group having the fewest number of titles. Then place the three-digit code(s) for that group into the group having the next fewest number of titles, such that the additional titles will not change the assigned sample number of the latter.

B. To remove two or more cases:

(1) If the highest sample number for three-digit groups is greater than "1," and if there are more three-digit groups with this value than there are cases to be removed, then apply the following rule: randomly select the same number of these groups as there are cases to be removed, and reduce the sample number of each selected group by "1."

(2) If the highest sample number is greater than "1," and if there are fewer groups with this value than there are cases to be removed then apply the following rule: subtract one from each group having the highest sampling number, and proceed to the groups with the next highest sample number. If this next value is greater than "1," then follow the appropriate steps as described in B(1) above in removing the remaining cases. If the next highest sample number equals "1," then follow the steps outlined in A(3) in removing the remaining cases.

(3) If all groups have a sample number of "1," then remove the necessary number of cases according to the procedure described in A(3), beginning with the group having the fewest number of titles for its sample number; then proceed to the group with the next fewest number of titles, and so on, until the appropriate number of excess cases has been removed.

Adding cases to the three-digit total. If the total across three-digit codes was less than the previously determined two-digit sample size, the required number of cases was added to the three-digit total by the following procedure:

A. To add one case:

(1) Find the three-digit group with the lowest sample number and increase its value by "1."

(2) If more than one group has the lowest sample number, then pick the group having the greatest number of titles and increase its sample number by "1."

B. To add two or more cases:

(1) If there are more groups having the lowest sample number than there are cases to be added, then apply the following rule: select those groups (with the lowest sample number) having the greatest number of titles and increase the sample number of each group by "1" until the number of cases to be added has been exhausted.

(2) If there are fewer groups having the lowest sample number than there are cases to be added, then apply the following rule: add one to each group having the lowest sample number, and then proceed to the groups with the next lowest sample number, and so on, applying the rule described in the preceding paragraph.

Drawing Cases from Three-Digit Groups

The steps involved in drawing the specified number of cases (i.e., the specified number of occupational titles) from each three-digit group are described below.

(1) If one case was to be drawn from a group containing only one three-digit code, then it was randomly drawn from the total number of titles in that three-digit code.

(2) If one case was to be drawn from a group containing more than one three-digit code, the following procedure was used:

(a) Draw randomly one case from the total number of titles in the group of three-digit codes.

(b) Determine under which three-digit code the selected case falls.

(c) Convert the selected number into the number it corresponds to within the three-digit code under which it falls. For example, suppose there are 3 three-digit codes within a group (013, 014, 015) and that 013 contains 3 titles, 014 contains 10 titles, and 015 contains 9 titles, resulting in a total of 22 titles for the combined three-digit group. If the randomly selected number is 18, then this number would fall under group 015; and within this code, the selected case would be the fifth title.

(3) If more than one case was to be drawn from a group containing only one three-digit code, the following procedure was used:

(a) Divide the total number of cases within the group into upper and lower halves. If the total number of cases in the three-digit code is odd, randomly assign the odd case to one of the halves.

(b) Randomly draw an equal number of cases from each of the two halves. If the number of cases to be drawn is odd, then choose randomly the half from which the odd case will be drawn. The division of cases into upper and lower halves is based on the fact that titles are arranged in order of skill level within three-digit codes; thus, dividing the total number of titles within a three-digit code into halves and drawing an equal number of cases from each half increases the likelihood of an even distribution of skill levels in the sample.

(4) If two or more cases were to be drawn from a group containing more than one three-digit code, the following procedure was used:

(a) Divide the cases for each three-digit code within the group into upper and lower halves.

(b) Place all upper halves for three-digit codes into one group (i.e., a total upper half) and all lower halves for the three-digit codes into another group (i.e., a total lower half).

(c) Randomly drawn an equal number of cases from each half, as described in 3(b) above.

(d) Convert the randomly selected numbers back to their appropriate numbers within the original three-digit codes, following the procedure described in paragraph 2(c) above.

Recording the Appropriate DOT Title and Six-Digit Code

After the appropriate numbers of the randomly selected cases within each three-digit code or group had been determined by the procedure described above, the occupational titles and six-digit codes corresponding to these cases were identified by counting down the appropriate number to base and defined related titles within each three-digit code. For example, if the randomly selected case within a three-digit code were 9, the ninth base or defined related title under that three-digit code was recorded along with its six-digit DOT number.

Appendix B

List of Jobs Comprising the Total Sample

Occupations in Architecture and Engineering (00-01)

1. 002.081 Maintainability Design Engineer (aerospace)
2. 003.081 Electronic Engineer (profess. & kin.)
3. 007.081 Tool Designer (aerospace)
4. 010.168 Production Engineer (petrol. production)
5. 011.281 Spectroscopist (profess. & kin.)
6. 012.188 Material Scheduler (aircraft mfg.)
7. 015.081 Nuclear Engineer (profess. & kin.)
8. 017.281 Draftsman, Detail (profess. & kin.)
9. 018.188 Surveyor (profess. & kin.)

Occupations in Mathematics and Physical Sciences (02)

10. 022.081 Chemist, Organic (profess. & kin.)
11. 024.081 Hydrologist (profess. & kin.)
12. 029.281 Laboratory Tester I (any ind.)

Occupations in Life Sciences (04)

13. 040.081 Microbiologist (profess. & kin.)
14. 041.281 Lab Technician, Microbiology

Occupations in Social Sciences (05)

15. 050.088 Market-Research Analyst I (profess. & kin.)

Occupations in Medicine and Health (07)

16. 074.181 Pharmacist (profess. & kin.)
17. 075.378 Nurse, General Duty (medical ser.)
18. 078.368 Bio-Instrumentation Technician
19. 079.178 Physical Therapist (medical ser.)

Occupations in Education (09)

20. 090.228 Faculty Member, College or University (education)
21. 091.118 Superintendent, Schools (education)

Occupations in Museum, Library, and Archival Sciences (10)

22. 102.168 Curator, Natural History Museum (museum)

Occupations in Law and Jurisprudence (11)

23. 119.288 Policy Technician (profess. & kin.)

Occupations in Writing (13)

24. 132.038 Editor, Sports (print. & pub.)
25. 139.168 Technical Reporting Analyst (aircraft mfg.)

Occupations in Art (14)

26.	141.081	Illustrator (profess. & kin.)
27.	142.081	Cloth Designer (profess. & kin.)
28.	143.382	Photographer, Finish (amuse. & rec.)

Occupations in Entertainment and Recreation (15)

29.	152.048	Bugler (amuse. & rec.)
30.	153.168	Racing Secretary and Handicapper (amuse. & rec.)
31.	159.228	Instructor, Bridge

Occupations in Administrative Specializations (16)

32.	160.188	Accountant (profess. & kin.)
33.	162.158	Buyer, Livestock (ret. tr.; slaught. & meat pack.; whole. tr.)
34.	163.118	Manager, Sales (any ind.)
35.	166.168	Personnel Representative (air trans.)
36.	166.168	Coordinator, Personnel Services (any ind.)
37.	169.168	Administrative Assistant (any ind.)

Managers and Officials, N.E.C. (18)

38.	180.118	Production Superintendent (wood preserv.)
39.	184.168	Superintendent, Tests (light, heat, & power)
40.	184.168	Manager, Warehouse (any ind.)
41.	185.168	Manager, Store (ret. tr.)
42.	186.118	Controller (profess. & kin.)
43.	187.168	Executive Housekeeper (hotel & rest.)
44.	187.168	Manager, Catering (hotel & rest.)
45.	188.118	Commissioner, Public Utilities (gov. ser.)
46.	189.118	Manager, Industrial Organization (any ind.)

Miscellaneous Professional, Technical, and Managerial Occupations (19)

47.	193.282	Radio Operator (light, heat, & power)
48.	196.168	Chief Pilot (air trans.)
49.	198.168	Conductor, Passenger Car (r.r. trans.)
50.	199.281	Gemologist (jewelry)

Stenography, Typing, Filing, and Related Occupations (20)

51.	204.288	Correspondence Clerk (clerical)
52.	208.588	Transcribing-Machine Operator (clerical)
53.	209.138	Agency Appointments Supervisor (insurance)

Computing and Account-Recording Occupations (21)

54.	210.388	Bookkeeping-Machine Operator I (clerical)
55.	211.468	Ticket Seller (clerical)

56. 213.582 Payroll Clerk (hosiery)
57. 216.488 Calculating-Machine Operator (clerical)
58. 219.368 Collection Clerk

Material and Production Recording Occupations (22)

59. 221.388 Production Clerk II (clerical)
60. 222.388 Label Processor
61. 222.587 Shipping Clerk II (clerical)
62. 222.588 Traffic Clerk (clerical)
63. 223.387 Stock Clerk (clerical)
64. 223.588 Tallyman (clerical)
65. 224.487 Weigher II (clerical)
66. 229.588 Ticketer (textile)

Information and Message Distribution Occupations (23)

67. 236.588 Telegrapher (r.r. trans.)
68. 239.138 Meter Reader, Chief (light, heat, & power; waterworks)

Miscellaneous Clerical Occupations (24)

69. 240.138 Credit Supervisor (finan. inst.)
70. 249.368 Order Clerk II (clerical)
71. 249.388 Authorizer, Regular Accounts (clerical)

Salesmen, Services (25)

72. 257.258 Representative, Personal Service (tel. & tel.)

Salesmen and Salespersons, Commodities (26, 27, 28)

73. 263.358 Salesperson, Men's Furnishings (ret. tr.)
74. 276.358 Salesman, Building and Construction, Equipment and Supplies (whole. tr.)
75. 283.458 Silver Saleslady (ret. tr.)
76. 289.358 Salesperson, Book (ret. tr.)

Merchandising Occupations, Except Salesmen (29)

77. 290.468 Groceryman, Journeyman (ret. tr.)
78. 298.081 Display Man (ret. tr.)
79. 299.868 Checker, Fitting Room (ret. tr.)

Food and Beverage Preparation and Service Occupations (31)

80. 313.381 Cook (hotel & rest.)
81. 314.878 Combination Girl (hotel & rest.)
82. 316.884 Meat Cutter (whole. tr.)

Lodging and Related Service Occupations (32)

83. 321.138 Housekeeper (hotel & rest.)
84. 329.874 Dock Attendant (water trans.)

Barbering, Cosmetology, and Related Service Occupations (33)

85. 332.271 Hair Stylist (per. ser.)

Amusement and Recreation Service Occupations (34)

86. 344.878 Press Box Custodian (amuse. & rec.)
87. 349.368 Receiving Barn Custodian (amuse. & rec.)

Miscellaneous Personal Service Occupations (35)

88. 355.878 Nurse Aide (medical ser.)
89. 359.868 Housemother (per. ser.)

Apparel and Furnishings Service Occupations (36)

90. 361.687 Assembler, Wet Wash (laundry)
91. 363.887 Glove Former (clean, dye & press; glove & mit)
92. 369.782 Starchwork Folder (laundry)

Protective Service Occupations (37)

93. 372.168 Guard, Captain (ret. tr.)
94. 372.368 Watchman I (any ind.)
95. 376.868 House Officer (hotel & rest.)

Building and Related Service Occupations (38)

96. 389.887 Light Cleaner (textile)

Plant Farming Occupations (40)

97. 403.887 Farm Hand, Vegetable II (agric.)
98. 404.883 Farm Hand (agric.)
99. 406.181 Grass Farmer (agric.)

Animal Farming Occupations (41)

100. 412.864 Egg Room Supervisor (agric.)
101. 419.883 Feeder (agric.)

Miscellaneous Farming and Related Occupations (42)

102. 421.883 Farm Hand, General (agric.)

Fishery and Related Occupations (43)

103. 431.884 Fisherman (Purse Seine) (fish.)

Forestry Occupations (44)

104. 441.384 Forester Aide (gov. ser.)

Agricultural Service Occupations (46)

105. 466.887 Livestock Caretaker, Yard-Or-In-Transit (any ind.)

Occupations in Processing of Metal (50)

106. 501.885 Plater (pen and pencil)
107. 502.130 Foreman, Plate Manufacturing (elec. equip.)
108. 504.885 Induction-Machine Operator (heat treat.)
109. 505.887 Production Operator (nickle plate)
110. 509.885 Process Equipment Operator (aircraft)

Ore Refining and Foundry Occupations (51)

111. 512.782 Furnace Operator (found., iron & steel)
112. 512.885 First Helper, Electric Furnace (found.)
113. 514.687 Casting Inspector (found.)
114. 515.885 Thimble Press Operator (ore. dress., smelt. & refin.)
115. 518.687 Core Labor; pilar (found.)
116. 519.887 Foundry Worker, General (found.)

Occupations in Processing of Food, Tobacco, and Related Products (52)

117. 520.885 Dividing-Machine Operator (bake. prod.)
118. 520.885 Chipping Machine Operator (slaught. & meat pack.)
119. 520.885 Mixer, Dry-Food Products (can. & preserv.)
120. 520.887 Seasoning Mixer (slaught. & meat pack.)
121. 521.885 Centrifuge Operator (can. & preserv.)
122. 521.885 Egg-Breaking Machine Operator (slaught. & meat pack.)
123. 521.885 Meat Grinder (slaught. & meat pack.)
124. 521.885 Sorting-Machine Operator (can. & preserv.)
125. 521.885 Crushing-Machine Operator (vinous liquors)
126. 522.782 Masher (malt liquors)
127. 522.887 Leadman (can. & preserv.)
128. 523.885 Ice Maker (ice)
129. 523.885 Blanching-Machine Operator (can. & preserv.)
130. 524.885 Icer, Machine (bake. prod.)
131. 525.884 Fish Cleaner (can. & preserv.; fish.)
132. 525.884 Egg Puller (can. & preserv.)
133. 526.782 Cook, Kettle (can. & preserv.)
134. 529.132 Chief, Feed Mill (feed & grain mill)
135. 529.687 Sorter, Agricultural Produce (agric.; can. & preserv.; whole. tr.)

136. 529.782 Dairy Processing Equipment Operator (dairy prod.)
137. 529.885 Noodle Maker (macaroni & rel. prod.)
138. 529.885 Washer, Agricultural Produce (can. & preserv.)
139. 529.887 Laborer (slaught. & meat pack.)

Occupations in Processing of Paper and Related Materials (53)

140. 533.782 Bleacher Man, Pulp (paper & pulp)
141. 534.885 Paraffiner Operator (paper goods)
142. 539.782 Foundrinier-Machine Tender (paper & pulp)

Occupations in Processing of Petroleum, Coal, Natural and Manufactured Gas, and Related Products (54)

143. 541.885 Screenman (coke prod.)
144. 544.885 Breaker Tender (coke prod.)
145. 549.132 Paste Plant Shift Foreman (ore dress., smelt & refin.)

Occupations in Processing of Chemicals, Plastics, Synthetics, Rubber, Paint, and Related Products (55)

146. 550.782 Banbury-Mixer Operator (any ind.)
147. 550.884 Dye Weigher (any ind.)
148. 550.884 Finish Mixer (textile)
149. 551.885 Extractor Operator, Solvent Process (chem.; wood distil. & charc.)
150. 551.885 Centrifuge Operator (paint. & varn.)
151. 552.885 Batch-Still Operator I (agric.)
152. 553.885 Ammonium-Nitrate Crystallizer (explosives)
153. 553.885 Flaker Operator (chem.)
154. 553.885 Drier Operator (glue)
155. 554.782 Coater (drug prep. & related prod.)
156. 555.885 Scratcher Tender (linoleum)
157. 556.782 Compressor (drug prep. & rel. prod.; salt prod.)
158. 556.885 Injection-Molding-Machine Tender (fabric. plastic prod.)
159. 557.782 Extruder Operator (fabric. plastic prod.)
160. 558.138 Manager, Soap and Synthetics and Glycerin (soap)
161. 558.885 Twitchell Operator (chem.)
162. 559.130 Polymerization Foreman (plastics mat.)
163. 559.132 Foreman, Record Press (phonograph)
164. 559.782 Acid Maker (paper & pulp)
165. 559.782 Chemical Operator III (chem.)
166. 559.885 Frame Stripper (soap)
167. 559.885 Tank Farm Attendant (chem.)
168. 559.885 Dope-Dry-House Operator (explosives)

Occupations in Processing of Wood and Wood Products (56)

169. 561.782 Treating Engineer (wood preserv.)
170. 569.885 Glue Spreader, Veneer (veneer & plywood)

Occupations in Processing of Stone, Clay, Glass, and Related Products (57)

171.	570.885	Tubemill Operator (cement)
172.	573.782	Kiln Burner (brick & tile)
173.	574.782	Spray-Machine Operator (pottery & porc.)
174.	575.380	Semiconductor Technician (press set-up)
175.	575.887	Ram Press Operator Helper (pottery & porc.)
176.	579.687	Selector (glass mfg.)
177.	579.885	Silver Stripper, Machine (mirror)

Occupations in Processing of Leather, Textiles, and Related Products (58)

178.	580.885	Hat-Blocking-Machine Operator (hat & cap)
179.	581.885	Tumbler Tender (hosiery; knit goods; tex. prod., n.e.c.)
180.	582.885	Cloth Bleaching-Range Middleman (textile)
181.	582.885	Conditioner Tender (textile; hosiery)
182.	582.886	Raw-Stock Tubman (textile)
183.	583.885	Brim-And-Crown Presser (hat & cap)
184.	583.886	Glove Turner and Former, Automatic (glove & mit)
185.	584.885	Glue-Spreading-Machine Operator (leather products)
186.	585.885	Trimmer (knit goods)
187.	587.885	Duster (hat & cap)
188.	589.137	Cloth Finisher I (textile)
189.	589.885	Boarding-Machine Operator (hosiery)

Processing Occupations, N. E. C. (59)

190.	590.132	Foreman (candle)
191.	590.885	Firer (electronics)
192.	599.885	Impregnating Tank Operator I (any ind.)

Metal Machining Occupations (60)

193.	600.380	Machine Set-Up Operator (mach. shop)
194.	601.280	Tool-And-Die Maker (mach. shop)
195.	603.782	Honing Machine Set-Up Operator, Tool (mach. shop)
196.	603.782	Grinder Set-Up Operator, External (mach. shop)
197.	604.280	Turret-Lathe-Set-Up Operator, Tool (mach. shop)
198.	605.782	Broaching Machine Set-Up Operator (mach. shop)
199.	606.280	Boring-Mill Set-Up Operator, Horizontal (mach. shop)
200.	607.782	Extrusion Saw Operator (struct. & ornam. metalwork)
201.	609.782	Balancing-Machine Operator (any ind.)

Metalworking Occupations, N. E. C. (61)

202.	611.782	Pressman (forging)
203.	613.885	Silversmith Helper
204.	614.886	Die Head Man; Die Header (struct. & ornam. metalwork)
205.	615.782	Punch-Press Operator I (any ind.)

206.	615.885	Shear Operator II (any ind.)
207.	616.130	Shift Foreman, Specialty Manufacturing (iron & steel)
208.	617.885	Punch-Press Operator II (any ind.)
209.	619.380	Fabricator A-Cutting Department (any ind.)
210	619.885	Four Slide Machine Operator (any ind.)

Mechanics and Machinery Repairman (62, 63)

211.	620.281	Automobile Mechanic (auto ser.)
212.	621.131	Foreman, Production Department (aerospace)
213.	623.281	Boat Mechanic (water trans.)
214.	628.884	Reed Man (textile)
215.	629.281	Powder-Line Repairman (explosives)
216.	630.781	Propellant-and-Gas Mechanic (aircraft mfg.)
217.	633.281	Scale Mechanic (any ind.)
218.	638.281	Millwright (any ind.)
219.	639.281	Sewing-Machine Repairman (any ind.)

Paperworking Occupations (64)

220.	640.885	Corner Cutter (paper goods)
221.	641.885	Sealing-Machine Operator (paper goods)
222.	649.780	Bag Machine Adjuster (paper goods)

Printing Occupations (65)

223.	651.782	Flexographic Pressman I (print. & pub.)
224.	652.887	Wallpaper-Printer Helper (wallpaper)
225.	653.782	Folding-Machine Operator (print. & pub.)
226.	654.782	Ludlow-Machine Operator (print. & pub.)

Wood Machining Occupations (66)

227.	661.281	Patternmaker, Wood (found.)
228.	663.885	Veneer Clipper (veneer & plywood)
229.	665.782	Dovetail Machine Operator (woodworking)
230.	667.782	Gang Sawyer (sawmill)
231.	667.885	Cut-Off Sawyer Log (paper & pulp; sawmill)
232.	668.782	Profile-Shaper Operator, Automatic (woodworking)
233.	669.130	Foreman (mort. goods)

Occupations in Machining Stone, Clay, Glass, and Related Materials (67)

234.	673.885	Blocker, Automatic (glass mfg.; mirror)
235.	677.782	Sawman (asbestos prod.)

Textile Occupations (68)

236.	680.885	Drawing-Frame Tender (textile)
237.	681.887	Utility Man (Preparation Winding) (textile)
238.	682.885	Spinner, Frame (asbestos prod.; textile)

239.	683.782	Weaver, Narrow Fabrics (asbestos prod.; narrow fabrics)
240.	685.780	Threader (knit goods; tex. prod., n.e.c.)
241.	686.885	Strip-Cutting-Machine Operator (any ind.)
242.	689.885	Braiding-Machine Operator (asbestos products; narrow fabrics)
243.	689.885	Garnetter (felt goods; house furn.; matt. & bedsprings; waste & batting)
244.	689.887	Creeler (any ind.)

Machine Trades Occupations, N. E. C. (69)

245.	690.782	Stitcher, Special Machine (boot & shoe)
246.	690.885	Assembly-Press Operator (any ind.)
247.	690.885	Electrical Assembler (coin mach.)
248.	690.885	Filler (boot & shoe)
249.	691.885	Armoring-Machine Operator (insulated wire)
250.	692.280	Maintenance Mechanic, Wire Department (electronics)
251.	692.885	Dynamite-Cartridge Crimper (explosives)
252.	692.885	Assembler Machine Operator
253.	692.885	Stapling-Machine Operator (any ind.)
254.	693.381	Model Maker I (aircraft mfg.)
255.	699.887	Oiler I (any ind.)

Occupations in Fabrication, Assembly, and Repair of Metal Products, N. E. C. (70)

256.	700.884	Polisher (jewelry)
257.	703.687	Water Tester (Can Tester) (tinware)
258.	704.887	Chemical-Milling Scriber (aircraft mfg.)
259.	705.884	Finisher (silverware)
260.	706.381	Precision Assembly Mechanic (aircraft)
261.	706.884	Vending Machine Assembler (coin mach.)
262.	709.281	Spar Mechanic (ship & boat bldg. & rep.)
263.	709.884	Tube Finisher and Assembler "A" (aircraft mfg.)

Occupations in Fabrication and Repair of Scientific and Medical Apparatus, Photographic and Optical Goods, Watches and Clocks, and Related Products (71)

264.	710.131	Assembly Foreman (inst. & app.)
265.	710.884	Solderer (inst. & app.)
266.	710.884	Instrument Assembler (inst. & app.)
267.	711.884	Polisher, Hand (inst. & app.)
268.	712.281	Dental Ceramist (medical ser.)
269.	712.381	Dental Laboratory Technician (medical ser.)
270.	712.884	Metal Finisher (medical ser.)
271.	712.887	Assembler
272.	714.281	Maintenance Man, Factory or Mill (any ind.)
273.	716.781	Assembler, Suspension Component "A"
274.	716.884	Assembler (electronics)
275.	716.884	Electronic-Sensing-Equipment Assembler (inst. & app.)
276.	716.884	Instrument Adjuster (inst. & app.)

Occupations in Assembly and Repair of Electrical Equipment (72)

277.	721.884	Heavy Assembler (elec. equip.)
278.	723.132	Factory Supervisor (light. fix.)
279.	724.884	Inspector, Finished Goods (coin mach.)
280.	725.281	Tailor II (ret. tr.)
281.	726.884	Boat Loader (electronics)
282.	726.884	Semiconductor Assembler (electronics)
283.	727.887	Paraffin Tank Operator (elec. equip.)
284.	728.884	Bench Assembler (coin mach.)
285.	729.387	Checker and Tester (elec. equip.)

Occupations in Fabrication and Repair of Products Made From Assorted Materials (73)

286.	731.885	Assembler V (tire setter, car) (toys & games)
287.	732.884	Bracket Mounter (sports equip.)
288.	732.884	Formica Trim Assembler (sports equip.)
289.	732.887	Coverer Helper (sports equip.)
290.	733.130	Foreman, Plating and Point Assembly (pen & pencil)
291.	733.137	Foreman, Refill Assembly (pen & pencil)
292.	733.381	Typesetter (pen & pencil)
293.	733.887	Seal Press Assembler (pen & pencil)
294.	734.884	Button Maker (furn.)
295.	735.884	Bead Stringer (jewelry)
296.	735.887	Stone Setter (jewelry)
297.	739.687	Inspector-Packer (match)
298.	739.884	Assembler, Metal Furniture (furn.)
299.	739.887	Assembler, Small Products (any ind.)
300.	739.887	Gluer II (any ind.)

Painting, Decorating, and Related Occupations (74)

301.	740.884	Decorator (pottery & porc.)
302.	749.884	Putty Glazer (any ind.)

Occupations in Fabrication and Repair of Plastics, Synthetics, Rubber, and Related Products (75)

303.	750.887	Tire Mounter (fabric. prod., n.e.c.)
304.	751.887	Receiving Clerk, Plastics (tex. prod., n.e.c.)
305.	752.884	Bit Bender (smoking pipe)
306.	754.884	Grinder (ship & boat bldg. & rep.)
307.	759.384	Emergency Equipment Repairman (air trans.)

Occupations in Fabrication and Repair of Wood Products (76)

308.	761.887	Sander, Hand (woodworking)
309.	762.884	Glueman (woodworking)
310.	763.884	Frame Maker (furn.)
311.	764.887	Firetender (cooperage)
312.	769.687	Inspector-Packer

Occupations in Fabrication and Repair of Sand, Stone, Clay, and Glass Products (77)

313.	770.281	Top Brilliandeer; Bottom Brilliandeer (jewelry)
314.	774.384	Finish Inspector-Instructor (pottery & porc.)
315.	775.687	Mirror Inspector, Face Cleaner Tailer and Examiner (mirror)
316.	777.381	Patternmaker, Plaster (aircraft mfg.)
317.	779.883	Power-Shovel Operator (any ind.)

Occupations in Fabrication and Repair of Textile, Leather, and Related Products (78)

318.	780.884	Cushion Man (furn.)
319.	780.884	Upholsterer II (furn.)
320.	781.381	Patternmaker (garment)
321.	781.884	Rug Clipper (carpet & rug)
322.	782.884	Hosiery Mender (hosiery; per. ser.)
323.	784.884	Braided Band Assembler (hat & cap)
324.	784.887	Powderer (hat & cap)
325.	785.138	Supervisor Alteration Workroom (ret. tr.)
326.	786.782	Sewing Machine Operator, Regular Equipment (garment)
327.	787.782	Binder II (any ind.)
328.	787.782	Brim-Welt-Sewing-Machine Operator (hat & cap)
329.	787.782	Edger (glove & mit; leather prod.; textile)
330.	787.782	Hemmer (any ind.)
331.	788.885	Edge Shaper (boot & shoe)
332.	788.885	Bottom Ironer, Machine (boot & shoe)
333.	788.887	Tapes Top Line of Quarters (boot & shoe)
334.	789.687	Inspector (fabric. tex. prod.)
335.	789.887	Sample Serviceman (carpet & rug)
336.	789.887	Sample Girl (carpet & rug)

Bench Work Occupations, N. E. C. (79)

337.	794.281	Assistant Product Development Man (paper goods)
338.	799.381	Upholsterer (ship & boat bldg. & rep.)

Occupations in Metal Fabricating, N. E. C. (80)

339.	801.381	Aircraft Mechanic, Rigging and Controls (aircraft mfg.)
340.	804.281	Sheet-Metal Worker (found.)
341.	806.781	Air-Conditioning Installer, General (aircraft mfg.)
342.	806.884	Engine Assembler
343.	807.381	Inspector, Fabrication (aircraft mfg.)
344.	809.131	Yard Superintendent (ship & boat bldg. & rep.)

Welders, Flame Cutters, and Related Occupations (81)

345.	814.884	Can Solderer (electronics)
346.	819.381	Welder (welding)

Electrical Assembling, Installing, and Repairing Occupations (82)

347.	821.885	Bread Chopper (can. & preserv.)
348.	822.131	Senior Communications Electrician (light, heat, & power)
349.	825.281	Aircraft Mechanic, Electrical (aircraft mfg.)
350.	827.384	Cooling-Tank Tester (agric. equip.)
351.	828.281	Electrician A (mach. shop)
352.	829.884	Electrician Helper (any ind.)

Painting, Plastering, Waterproofing, Cementing, and Related Occupations (84)

353.	840.781	Painter, Maintenance (any ind.)
354.	842.884	Ceiling Man (trans. equip.)

Excavating, Grading, Paving, and Related Occupations (85)

355.	850.883	Scraper Operator (any ind.)
356.	851.884	Pipe Layer (const.)
357.	859.883	Operating Engineer II (const.)
358.	859.887	Jackhammer Operator (const.)

Construction Occupations, N. E. C. (86)

359.	860.887	Carpenter Helper, Maintenance (any ind.)
360.	861.381	Bricklayer Helper
361.	861.381	Lip-and-Gate Builder and Oiler Maintenance Man (glass mfg.)
362.	862.381	Pipe Fitter, Maintenance (any ind.)
363.	862.884	Soft-Water Serviceman (bus. ser.)
364.	864.781	Carpenter-Floor Rolling (trans. equip.)
365.	869.134	Foreman (Finish Flooring) (trans. equip.)
366.	869.884	Utility Man (Flooring) (trans. equip.)

Structural Work Occupations, N. E. C. (89)

367.	899.884	Maintenance-Man Helper, Factory or Mill (any ind.)

Motor Freight Occupations (90)

368.	909.883	Truck Driver (any ind.)

Transportation Occupations, N. E. C. (91)

369.	910.884	Switchman
370.	911.873	Dockmaster (water trans.)
371.	913.883	Chauffeur (any ind.)
372.	914.885	Soapery Pumper (any ind.)
373.	915.137	Car Wash Supervisor (auto. ser.)
374.	919.883	Routeman (bus. ser.)

Packaging and Materials Handling Occupations (92)

375. 920.885 Packager, Machine (any ind.)
376. 920.885 Filling-Machine Operator (any ind.)
377. 920.886 Labeler (carpet & rug)
378. 920.887 Shipping Processor (aircraft mfg.)
379. 921.883 Fork-Lift-Truck Operator (any ind.)
380. 921.883 Locomotive Crane Operator (any ind.)
381. 922.487 Warehouseman (dairy prod.)
382. 922.887 Laborer, Stores (any ind.)
383. 929.883 Grain Elevator Man (grain & feed mill)
384. 929.887 Material Handler (whole. tr.)

Occupations in Extraction of Minerals (93)

385. 939.131 Production Foreman (petrol. prod.)
386. 939.782 Playback Operator (petrol. prod.)
387. 939.782 Panelboard Operator (mining & quarrying; ore dress.; smelt.; & refin.)

Occupations in Logging (94)

388. 941.488 Log Scaler (logging; veneer & pulp; and sawmill)
389. 942.883 Log Stacker Operator (sawmill)

Occupations in Production and Distribution of Utilities (95)

390. 950.782 Stationary Engineer (any ind.)
391. 952.262 Crew Leader-Power House (any ind.)
392. 957.288 Field Engineer (electronics)
393. 959.387 Patrolman (light, heat, & power)

Amusement, Recreation, and Motion Picture Occupations, N. E. C. (96)

394. 960.382 Quality Control Projectionist (photo. process. & finish.)
395. 969.687 Film Inspector I (motion pict.)

Occupations in Graphic Art Work (97)

396. 970.381 Checker-Packager (photo. process. & finish.)
397. 971.381 Screen Maker, Photographic Process (any ind.)
398. 973.381 Collator
399. 976.884 Slitter, Processed Film (any ind.)
400. 979.381 Copy Camerman (any ind.)

Appendix C

List of Jobs Employed in the Reliability Study

The jobs employed in the reliability analyses are listed below. Jobs 1 through 67 were employed in analysis 1, jobs 68 through 134 in analysis 2. The entire list of jobs was employed in analysis 3.

	DOT Code	Job Title
1.	002.081	Maintainability Design Engineer
2.	010.168	Production Engineer
3.	041.281	Lab Technician, Microbiology
4.	102.168	Curator, Natural History Museum
5.	159.228	Instructor, Bridge
6.	166.168	Personnel Representative
7.	187.168	Executive Housekeeper
8.	189.118	Manager, Industrial Organization
9.	213.582	Payroll Clerk
10.	222.388	Label Processor
11.	222.588	Traffic Clerk
12.	249.368	Order Clerk II
13.	283.458	Silver Saleslady
14.	289.358	Salesperson, Book
15.	376.868	House Officer
16.	389.887	Light Cleaner
17.	412.864	Egg Room Supervisor
18.	431.884	Fisherman
19.	520.885	Chipping Machine Operator
20.	521.885	Centrifuge Operator
21.	522.887	Leadman
22.	526.782	Cook, Kettle
23.	529.687	Sorter, Agricultural Produce
24.	529.887	Laborer
25.	550.884	Dye Weigher
26.	553.885	Flaker Operator
27.	558.138	Manager, Soap & Synthetics & Glycerin
28.	559.782	Acid Maker
29.	579.687	Selector
30.	582.885	Conditioner Tender
31.	583.885	Brim-And-Crown Presser
32.	601.280	Tool-And-Die Maker
33.	603.782	Honing Machine Set-Up Operator, Tool
34.	615.782	Punch-Press Operator I
35.	619.380	Fabricator A-Cutting Department
36.	630.781	Propellant-And-Gas Mechanic
37.	641.885	Sealing-Machine Operator
38.	663.885	Veneer Clipper
39.	682.885	Spinner, Frame
40.	689.885	Braiding-Machine Operator
41.	692.280	Maintenance Mechanic, Wire Department
42.	693.381	Model Maker I
43.	706.884	Vending Machine Assembler
44.	710.884	Solderer
45.	712.381	Dental Laboratory Technician

	DOT Code	Job Title
46.	716.884	Assembler
47.	731.885	Assembler V
48.	732.884	Formica Trim Assembler
49.	749.884	Putty Glazer
50.	750.887	Tire Mounter
51.	762.884	Glueman
52.	774.384	Finish Inspector-Instructor
53.	780.884	Cushion Man
54.	786.782	Sewing Machine Operator, Regular Equipment
55.	788.887	Tapes Top Line of Quarters
56.	801.381	Aircraft Mechanic, Rigging & Controls
57.	804.281	Sheet-Metal Worker
58.	809.131	Yard Superintendent
59.	814.884	Can Solderer
60.	850.883	Scraper Operator
61.	862.884	Soft-Water Serviceman
62.	911.873	Dockmaster
63.	913.883	Chauffeur
64.	929.887	Material Handler
65.	941.488	Log Scaler
66.	950.782	Stationary Engineer
67.	970.381	Checker-Packager
68.	011.281	Spectroscopist
69.	029.281	Laboratory Tester I
70.	050.088	Market-Research Analyst I
71.	075.378	Nurse, General Duty
72.	152.048	Bugler
73.	160.188	Accountant
74.	169.168	Administrative Assistant
75.	193.282	Radio Operator
76.	219.368	Collection Clerk
77.	221.388	Production Clerk II
78.	223.588	Tallyman
79.	249.388	Authorizer, Regular Accounts
80.	263.358	Salesperson, Men's Furnishings
81.	316.884	Meat Cutter
82.	329.874	Dock Attendant
83.	355.878	Nurse Aide
84.	363.887	Glove Former
85.	441.384	Forester Aide
86.	466.887	Livestock Caretaker, Yard-Or-In-Transit
87.	512.885	First Helper, Electric Furnace
88.	519.887	Foundry Worker, General
89.	521.885	Sorting-Machine Operator
90.	525.884	Fish Cleaner
91.	529.885	Noodle Maker
92.	541.885	Screenman
93.	551.885	Centrifuge Operator
94.	553.885	Drier Operator

	DOT Code	Job Title
95.	557.782	Extruder Operator
96.	559.132	Foreman, Record Press
97.	570.885	Tubemill Operator
98.	573.782	Kiln Burner
99.	585.885	Trimmer
100.	600.380	Machine Set-Up Operator
101.	604.280	Turret-Lathe-Set-Up Operator, Tool
102.	611.782	Pressman
103.	617.885	Punch-Press Operator II
104.	628.884	Reed Man
105.	661.281	Patternmaker, Wood
106.	667.885	Cut-Off Sawyer Log
107.	683.782	Weaver, Narrow Fabrics
108.	689.885	Garnetter
109.	690.885	Filler
110.	699.887	Oiler I
111.	700.884	Polisher
112.	709.884	Tube Finisher and Assembler "A"
113.	721.884	Heavy Assembler
114.	723.132	Factory Supervisor
115.	726.884	Boat Loader
116.	733.130	Foreman, Plating and Point Assembly
117.	733.381	Typesetter
118.	739.884	Assembler, Metal Furniture
119.	763.884	Frame Maker
120.	769.687	Inspector-Packer
121.	777.381	Patternmaker, Plaster
122.	780.884	Upholsterer II
123.	787.782	Hemmer
124.	799.381	Upholsterer
125.	806.781	Air-Conditioning Installer, General
126.	828.281	Electrician A
127.	859.883	Operating Engineer II
128.	861.381	Lip-And-Gate Builder & Oiler Maintenance Man
129.	869.134	Foreman
130.	920.885	Packager, Machine
131.	920.887	Shipping Processor
132.	921.883	Locomotive Crane Operator
133.	952.262	Crew Leader-Power House
134.	959.387	Patrolman

Appendix D

OAI Items Excluded from the Factor Analyses

The OAI items which were not included in the six factor analyses are listed below under their appropriate sections.

Information Received

The following items were omitted: 35i, 36i, 41i, 42i, 54i, 58i, 60i, 64i through 68i, 71i, 72i, 75i through 78i, 88i, 90i, 103i, 105i, 108i, 110i, 114i, 116i through 125i.

Mental Activities

The following items were omitted: 1m, 14m, 27m.

Physical Work Behavior

The following items were omitted: 17t, 18t, 19t, 22t through 25t, 27t, 28t, 31t, 32t, 34t through 40t, 44t, 46t, 48t, 51t, 52t, 53t, 66t, 68t, 69t, 72t, 73t, 74t, 76t, 89t, 94t, 95t, 6a, 12a, 21a, 22a, 23a, 41a, 48a, 52a, 54a, 55a, 3j, 4j, 8j, 15j, 18j, 21j, 24j, 29j, 33j, 35j through 41j.

Representational Work Behavior

The following items were omitted: 4r, 5r, 11r, 12r, 13r, 21r, 24r.

Interpersonal Work Behavior

The following items were omitted: 4p, 17p, 18p, 19p, 22p, 24p, 26p, 33p, 34p.

Work Goals

The following items were omitted: 30g, 32g, 40g through 45g, 47g, 48g, 49g, 51g, 52g, 53g, 55g, 56g, 58g through 62g, 64g, 65g, 67g, 68g, 69g, 71g, 86g, 98g, 106g, 109g, 110g, 111g, 112g.

Work Context

The following items were omitted: 5c, 7c, 23c, 28c, 35c, 38c, 39c, 40c, 42c, 44c, 55c, 56c, 60c through 77c.

Appendix E

Intercorrelations Between Factors in Each of the
Seven Sectional Analyses

Table 13. Factor Correlation Matrix for the Information Received Section of the OAI

	Factor																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Factor																	
1	1.00	.02	.18	.04	.12	.00	.14	.09	.02	-.11	.24	-.06	-.05	.02	.12	.25	.02
2		1.00	.05	.03	-.04	.22	.16	-.01	.27	-.02	-.06	-.23	.02	.28	.05	.21	-.06
3			1.00	.06	.22	.05	.16	-.03	.00	-.11	.22	-.05	-.03	.01	.06	.19	.03
4				1.00	.03	.06	.11	-.02	.01	-.08	.00	-.03	.00	.02	.09	.11	-.01
5					1.00	-.02	.19	-.06	-.09	.00	.15	.05	-.02	-.07	.05	.17	.12
6						1.00	.07	.08	.12	-.11	.02	-.16	.22	.07	.02	.14	.00
7							1.00	.06	.06	-.13	.08	.00	.06	.07	.08	.20	.21
8								1.00	.17	.05	.15	-.11	.34	.03	.02	.10	.08
9									1.00	.00	-.03	-.19	.04	.19	.00	.19	.00
10										1.00	-.02	.04	-.05	.05	-.05	-.04	-.07
11											1.00	-.05	-.10	-.14	.11	.26	.07
12												1.00	-.03	-.17	-.06	-.13	-.02
13													1.00	.01	-.03	-.03	-.03
14														1.00	.04	.09	-.05
15															1.00	.17	.04
16																1.00	.10
17																	1.00

Table 14. Factor Correlation Matrix for the Mental Activities Section of the OAI

	Factor						
	1	2	3	4	5	6	7
Factor							
1	1.00	.21	.23	.35	.46	.06	- .29
2		1.00	.26	.24	.19	.22	- .02
3			1.00	.25	.16	.16	- .31
4				1.00	.29	.16	- .21
5					1.00	.00	- .25
6						1.00	- .04
7							1.00

Table 15. Factor Correlation Matrix for the Physical Work Behavior Section of the OAI

	Factor																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Factor																	
1	1.00	.16	- .04	.08	- .13	- .02	.03	- .02	.06	.01	.07	.08	.03	- .04	.00	.11	.02
2		1.00	- .10	.04	- .09	.06	- .01	- .02	- .04	.02	.00	.09	- .03	- .03	.03	.05	.03
3			1.00	- .06	.07	- .03	- .06	- .03	- .04	.12	- .02	- .07	.05	- .02	- .02	- .09	- .07
4				1.00	- .04	- .07	.01	- .10	.03	- .03	.02	.08	.01	.01	- .03	- .10	.02
5					1.00	.01	- .11	- .00	- .01	.00	- .12	.01	.06	- .08	.00	- .08	.01
6						1.00	- .05	- .01	.05	- .02	.05	- .08	- .02	.05	- .06	- .00	.01
7							1.00	- .06	.07	- .04	.12	.02	- .02	.07	.02	.03	.08
8								1.00	- .04	.02	- .11	- .05	.00	.06	.02	- .08	.00
9									1.00	.03	.10	.03	.01	.06	- .04	.06	.04
10										1.00	.00	- .04	.04	.00	- .03	- .04	- .07
11											1.00	.01	.00	.00	- .05	.06	.00
12												1.00	.00	- .05	.04	.06	.03
13													1.00	- .06	- .02	- .02	.02
14														1.00	- .03	.01	- .01
15															1.00	.01	.01
16																1.00	- .01
17																	1.00

Table 16. Factor Correlation Matrix for the Representational Work Behavior Section of the OAI

	Factor					
	1	2	3	4	5	6
Factor						
1	1.00	.26	.22	- .47	.36	.12
2		1.00	.15	- .23	.30	.06
3			1.00	- .37	.18	.16
4				1.00	- .35	- .05
5					1.00	.06
6						1.00

Table 17. Factor Correlation Matrix for the Interpersonal Work Behavior Section of the OAI

	Factor						
	1	2	3	4	5	6	7
Factor							
1	1.00	.22	- .20	.33	.19	.06	- .09
2		1.00	- ,09	.31	.09	.26	- .09
3			1.00	- .10	- .16	.00	- .02
4				1.00	- .16	.18	- .09
5					1.00	.02	.00
6						1.00	- .07
7							1.00

Table 18. Factor Correlation Matrix for the Work Goals Section of the OAI

	Factor														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Factor															
1	1.00	- .03	.09	- .08	.13	.06	- .22	.00	- .01	- .05	- .27	.06	.22	- .06	.16
2		1.00	.18	.11	- .05	.02	- .00	.01	- .02	.14	.06	.03	.08	- .01	.06
3			1.00	.03	.11	- .02	- .18	.10	.03	.16	.01	.02	.16	.04	.11
4				1.00	- .09	- .04	.05	.01	.05	.02	.04	.07	- .12	.00	.00
5					1.00	.02	.00	.00	- .02	.07	- .19	.04	.01	- .04	.09
6						1.00	- .03	.06	.00	.00	- .11	.06	.05	- .03	.12
7							1.00	- .09	.03	.04	.16	- .02	- .15	.02	- .15
8								1.00	.02	.03	- .04	.06	.08	- .02	.08
9									1.00	- .04	- .08	.02	- .01	.06	.01
10										1.00	.04	.00	- .01	.03	.06
11											1.00	- .08	- .10	.02	- .18
12												1.00	.00	- .08	.04
13													1.00	- .03	.14
14														1.00	.01
15															1.00

Table 19. Factor Correlation Matrix for the Work Context Section of the OAI

	Factor											
	1	2	3	4	5	6	7	8	9	10	11	12
Factor												
1	1.00	.09	- .04	- .19	.04	- .25	- .10	.02	.13	.02	- .04	.01
2		1.00	- .22	- .03	.02	.00	.09	.03	.11	- .12	.12	.10
3			1.00	- .05	.00	- .05	- .10	- .05	- .09	.02	.03	- .01
4				1.00	.15	.12	.03	.04	- .08	- .15	.06	.03
5					1.00	.00	.07	.00	.08	- .13	.08	.13
6						1.00	.08	.01	- .12	- .08	.12	.02
7							1.00	- .04	.04	- .09	.09	.08
8								1.00	.00	.00	.08	.03
9									1.00	.07	- .05	.01
10										1.00	- .12	- .03
11											1.00	.13
12												1.00

Report No. 1

Report No. 2

Report No. 3

Report No. 4

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